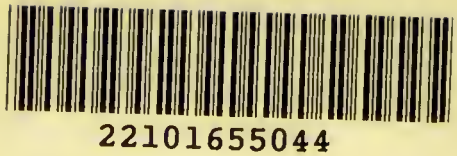

A GUIDE

TO THE SELECTION OF

ORTHOPÆDIC APPARATUS.

"'TIS NOT ENOUGH TO HELP THE FEEBLE UP, BUT TO SUPPORT HIM AFTER."—TIMON OF ATHENS, Act I. Sc. i.

A GUIDE

TO THE SELECTION AND ADAPTATION OF

ORTHOPÆDIC APPARATUS

With a detailed description of their salient points.

BY

F. GUSTAV ERNST,

ORTHOPÆDIC MECHANICIAN.

ILLUSTRATED BY FORTY-SIX "INK-PHOTO" PLATES AND SEVENTY-ONE WOOD-CUTS.

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1889.

PREFACE.

SO much success having attended the publication of my "Orthopædic Apparatus," and the little book having been entirely sold out of print, I have two duties to perform, the one, to thank those medical men who have so kindly encouraged me in my work, and who have so generously expressed their appreciation of the help rendered to them by the "illustrated Plates," and the other, the reproduction of the book.

In again illustrating the various apparatus for the treatment of deformities I shall endeavour to bring the use and practical points of each appliance more prominently into notice than heretofore, and for that purpose I may have to refer to the Authors who have so ably explained the application of the instruments in their several works. In doing this I trust that the Profession will view the liberty I have taken as a desire to assist those medical men who are not familiar with the perfect and exact use of the apparatus, and not with the idea of trespassing on that ground of "advice" which is clearly the province of the Medical Man.

As I intend to give the detailed description of the apparatus in chapters, I shall there refer fully to the special points of interest in the appliances, and consequently need not call attention here to any particular feature. I should, however, like to

ask one question which, I think, may fairly "preface" a description of "Orthopædic Apparatus," and that is, "Why is there existing so much prejudice against the use of mechanical appliances?" Surely, an infinite amount of good is done by their use when judiciously applied. Many deformities might be greatly lessened, and in many cases entirely cured by the timely application of a well-fitting and efficient apparatus; but unfortunately the prejudice exists against so-called "irons" (I speak of the general public); and what little deformity, it is fondly hoped, a child will "grow out of," only too often increases for want of a Medical Man's discriminating advice as to the best form of appliance necessary. The spinal apparatus, the walking instrument, the scarpas shoe, and other aids are all necessities, and as such should be made in accordance with the progress of science. It is this want of progress in the adaptation of certain appliances which seems to me to strike the keynote of the prejudice; and indeed, one can hardly wonder. I often see apparatus made in the present day, heavy, clumsy, ill-fitting, with the old ideas, and old models carried out, and presented as specimens of perfect mechanism. When nothing better could be obtained they served an end, but surely as science in surgery advances, should not also the science of the construction of Orthopædic Apparatus likewise advance? In these days when the possession of "certificates" is necessary to every one following any scientific pursuit, it is somewhat surprising to find that "Orthopædic and Surgical Instrument Makers" should carry on their vocation, without having demonstrated their ability to construct suitable apparatus, for the various cases which are submitted to them to be helped by

mechanical aid. That there are those who are well qualified to do this is unquestionable; but many, possessing only the technical knowledge of the workshop, manufacture articles so heavy and ill-fitting, and unsuitable, as to be productive of more harm than good to the wearer. A knowledge of the anatomy of the human frame should accompany a thorough acquaintance with the laws of mechanics, not that the mechanician should play the part of a quack, but that he may be enabled the more readily to grasp the ideas of medical men, and work out any apparatus without an endless experiment and waste of time, and consequent annoyance to both the surgeon and the patient. The preceding remarks are induced by personal experience. Frequently, I see patients who have had several apparatus made, all useless; alteration after alteration has followed, but the instrument still remains inefficient. Often the patient becomes wearied with these constant experiments, naturally is doubtful as to ever obtaining a "support," is prejudiced against appliances, and continues to suffer. This is not a fanciful case. Many medical men can, I am sure, thoroughly endorse this statement. Influenced by these facts, my aim has been, and is, to bring apparatus to perfection, and I shall endeavour to show that mechanical aids may be made thoroughly efficient, as well as perfectly comfortable.

The great secret of success in the application of my instruments rests in the careful fitting and adaptation which I give to each individual case, and without which no instrument can achieve its purpose. For instance, although there are a vast number of cases of lateral curvature of the spine, yet each must be treated on its own merits, and the apparatus adapted to the

requirements of the case. Moreover, as new treatments are developed and perfected, so in a like manner are my appliances altered and adapted, to be more effective and beneficial as adjuncts to the relief and cure of bodily deformities.

Having now glanced at the cause of this prejudice to "irons" (this word, by the way, a misnomer, iron being scarcely used in the construction of appliances), I trust that the following chapters may tend to disabuse the minds of those who hold ideas antagonistic to the employment of these important aids. I am confident that the force of my remarks must be apparent, and that a great need exists for the creation of "an Orthopædic and Surgical Mechanician's Certificate," not only for the production of instruments, but as a healthy stimulus to those engaged in this necessary and beneficial work.

F. GUSTAV ERNST.

80, Charlotte Street,
Fitzroy Square, London, W.
1889.

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CHAPTER I.

GENERAL DESCRIPTION OF MECHANISM.

BEFORE entering upon the description of Orthopædic apparatus, I think that it may be advisable to give an account of the various movements which are necessary as connecting or active parts of the several instruments. The joints especially are of great importance, and I believe that a detailed description will enable the medical man to see the nature of the movement, and whether the same is suitable for his case. This description will also give the technical terms, and consequently save much explanatory repetition in subsequent pages. Joints and springs are the two principal factors in all apparatus.

"Free Joints."

Commencing with joints; the simplest and that most largely used is the ordinary "double joint" or "Free Joint," so called from its capability of free movement in a given plane. This is composed of a male and female part, the former working within the latter, which latter ought always to be made of the solid piece for strength and durability. Figs. 1 and 2 shew a front and side view of this joint. It may seem superfluous to mention the solidity of this joint, but I have seen so many "made joints," i.e., one cheek overlapping the other, with the result of a joint of no durability in wear, and a constant liability to fracture across the rivet hole.

Fig. 1.

Fig. 2.

Use of the "Free Joint."

This joint is principally used in appliances for the upper and lower extremities, and is only adapted to instruments where slight support is required, and being actually "Free," it in no way impedes the natural action of the limb.

Detachable Joints.

Detachable joints are another kind of "free joint," and are principally adapted at the ankle joint.

Use of the Detachable Joint.

The chief object of a detachable joint is to admit of the separation of a portion of the instrument, and consequently the ankle joint is generally made with one or the other of the several forms of detachments. The value of this arrangement is very great, as it makes the change from a walking boot to a night shoe possible, or permits the use of several pairs of boots with one instrument. In a case of contracted knee, where the extension instrument is applied, this convenience for attaching a night shoe is obvious.

"Keyhole Catch" detachable joint.

The "Keyhole Catch" disconnection (so called from the shape of the cutting in the male joint) is the simplest form of detachable joint. It consists of a turned rivet, firmly attached to the ankle joint of the shoe-piece, the head forming the second cheek of the joint. The "pin" of the rivet and the centre hole of the male joint correspond in size. In the pin the top and underside are filed one quarter flat, and a sl-

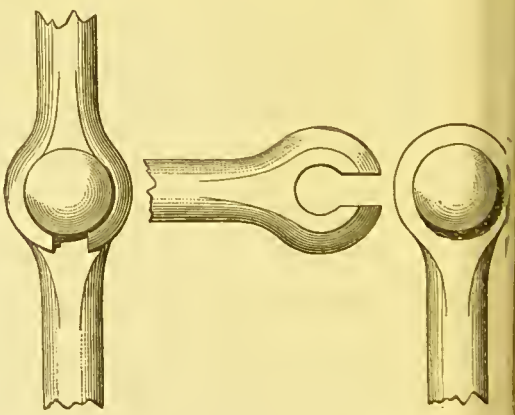


Fig. 4. Fig. 3.

is cut (of the thickness of the filed pin) from the lower end of the male joint into the centre hole. It will therefore be seen that to connect and disconnect the instrument from the ankle joint both the apparatus and shoe piece must be attached and detached at right angles to each other. Figs. 3 and 4 shew this form of joint before attachment, and when attached for use.

Sockets. Although not strictly a "working joint," yet sockets come under the head of detachments, and as such, the respective varieties may be described here. The simplest form of socket is that fastened to the heel of the boot, and of this form there are two sorts, the round and the flat. The former is generally applied to tibial instruments in cases where the curve of the

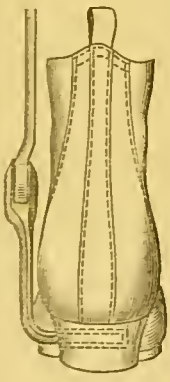


Fig. 5.

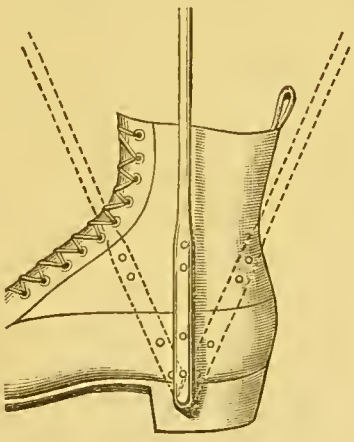


Fig. 6.

tibia is very low, and the latter applied in conjunction with the ordinary double or free joint at the ankle. Figs. 5 and 6 represent respectively a flat and round socket. Practically both of these forms of detachment I dislike, for if they are not constantly cleaned and oiled, the wet and dirt in walking, quickly clogs and corrodes the two metals and renders the detachment a fixture. Moreover, the round socket is mechanically

incorrect, for it places the centre of motion under the foot instead of at the ankle joint. However, many patients like the

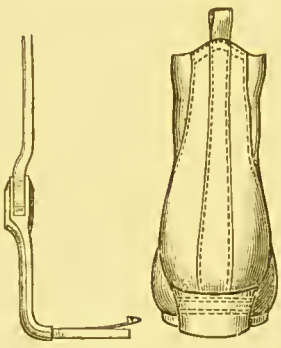


Fig. 7.

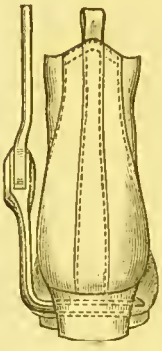


Fig. 8

socket detachment, and for greater security I would recommend

The "Snap Socket."

the "Snap Socket" as the more efficient of the horizontal series. Figs. 7 and 8 shew the working of this mechanism, the principal feature consisting in the spring which is attached to the shoe piece; this must be depressed before fixing and when detaching.

"Vertical Side Socket."

By far the more serviceable socket detachment is the "Vertical Side Socket." It is connected with a sole plate, in fact it is a solid steel forging (and for this reason alone infinitely superior to made sockets). The sole plate is firmly rivetted to the boot and the side portion receives the upper part of the instrument, which is made to fit it accurately. Fig. 9 shews this "Vertical Side Socket" arrangement before and after fixation. Often in "Free joints" a screw is inserted through the centre hole in place of a fixed rivet, theoretically

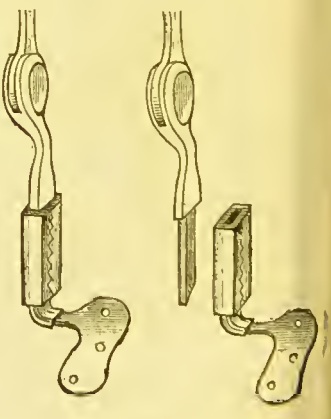


Fig. 9.

making a detachable joint, yet from the trouble of unscrewing and the wear of the thread of the screw, it becomes practically useless.

"Bevelled Morticed" Joints.

By far the neatest and most mechanical form of detachment is the "Bevelled Morticed" joint. In this case the detachment is made from above and not below the ankle joint, where the free movement is fitted in the usual way. The male joint of the double joint terminates at 2 inches in length, in a fitting resembling a distorted figure 3. It is "morticed" into the lower steel of the apparatus to prevent any lateral movement, and "bevelled" so that when placed together, both the upper and under side are in the same plane. When connected together a sliding ring passes over the two fittings and unites them in great solidity, this ring being kept in position by a spring catch.

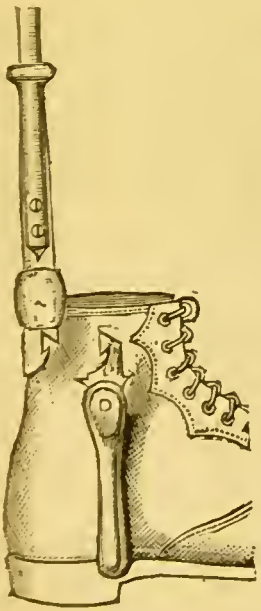


Fig. 10.

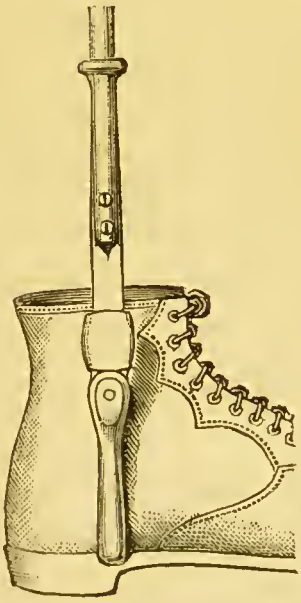


Fig. 11.

Use of the "Bevelled Morticed Joint."

In practice this form of detachment is exceedingly valuable, for it enables the adaptation of a night

shoe, or change of boots, *without* removing or disturbing any of the upper portion of the apparatus and experience has proved its efficiency and durability, for inasmuch as the detachment does not affect the ankle joint, there is an uniform wear of this part of the instrument and the value of the invention naturally increases on the point of economy alone. Figs. 10 and 11 give the details of this joint separate and intact.

"Ring Catch" Joint.

One of the most useful and valuable joints is the "Ring Catch" joint, which is used in walking apparatus for cases of paralysis, or weakened joints, and principally employed at the knee. It combines the advantages of a fixed and free movement, released or fixed at will. In construction it is similar to the ordinary free joint, but the male portion extends beyond the radius of the circular joint, in the shape of an angular fitting. The double or female joint is made with the upper part solid and to which is fitted a sliding ring. Figs. 12 and 13 show this joint "free" and "fixed." To fix the joint, the leg stems are brought into a straight line—the angular fittings of the male joint falling into the solid upper part of the female joint—and the ring is then slipped over the angular fitting which is now "flush" with the sides of the joints.

Fig. 13.

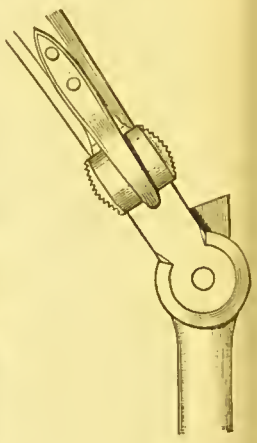


Fig. 12.

Principal use of the "Ring Catch" Joint.

This joint is largely used in walking apparatus for genu-valgum after both mechanical and operative

reatment, and by keeping the knee oint immovable during locomotion, est is given to the lax ligaments and firm support to the knee joint btained. This joint has in a measure uperseded the "Flute Key Catch" rrangement, for although the latter combines both a fixed and free joint, Figs. 14 and 15, et from the liability to fix whenever he limb is straightened, it is, in some ases, a source of constant trouble to ress the lever whenever free motion is requisite.

"Flute Key atch" Joint.

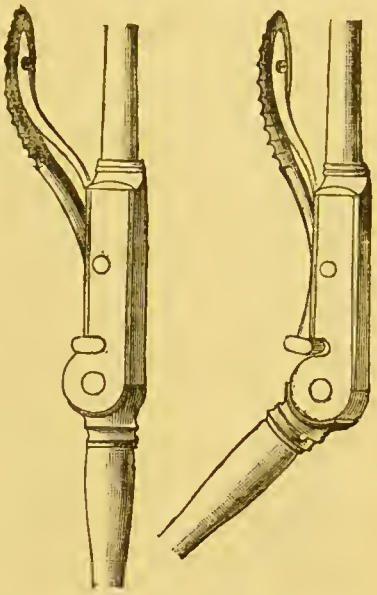


Fig. 14. Fig. 15.

"Rack and Pinion" Joint.

The next joint for reference is the all important "Rack and Pinion" movement. This is neither fixed" nor "free," but is capable of alteration to any angle. It is largely used in cases of contraction, and is the most powerful extending force which we possess, although at the same time it can be so accurately regulated as produce either a gentle or extreme degree of extension.

Use of the "Rack and Pinoin" Joint.

he mechanism consists of an endless crew called the "Pinion" which acts on eeth cut in the male joint, and which termed the "Rack." There are various ays of constructing the joint, but for urability and good work that shewn in ig. 16 is the best. This arrangement or extension has been devised to super-ede the long screw extension move-

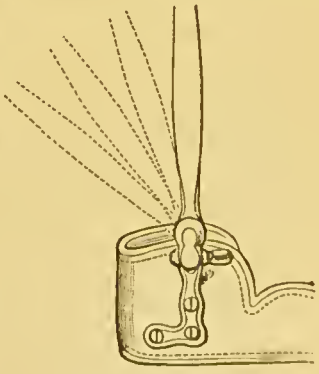


Fig. 16.

ment, *e.g.*, "McIntyre's Splint," and from its compactness and power, and easy method of adjustment it has been generally adopted in extension apparatus. Moreover a very prominent feature of its utility consists in the regulation being made by a key, rendering it impossible for the angle of extension to be altered after it has once been "set" by the surgeon (the key being separate from the apparatus).

The "Ball and Socket" Joint.

The "Ball and Socket" joint is a free joint in every sense of the word, but although "free" it is very limited as to range of motion, and is therefore not generally used. It can be very advantageously adapted as an auxiliary movement, and fitted with a "set" screw, is very useful in "arm" or "leg" apparatus to alter the plane or rotation of the upper and lower parts of the apparatus. Fig. 17 depicts this joint. The foregoing are the principal joints used in all apparatus, and these form the base of modified or multipliable movements. For instance a "Stop" joint can be composed either by the male joint being left fuller at one point of its circumference or by a slot being cut and a screw passed through the double joint. Yet the foundation of the joint is of the same principle and construction as the "free" joint. These several varieties and modifications need not be given here, as I shall refer to them as they occur in the following chapters.

Use of the "Ball and Socket" Joint.

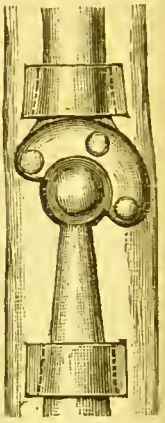


Fig. 17.

"Stop" Joints.

Use of the "Stop" Joint.

Judging from the apparatus one sees, the use of "Stop" joints seems to be little understood. Frequently

I see appliances, especially for the lower extremities, made with the knee joint absolutely free. Anatomically this is incorrect, the leg, except in lax conditions of joints (I speak of the knee), stops when the vertical axis is attained, similarly all leg instruments should stop at this line, so that efficient support may be given to the leg. With a perfectly "free" joint this does not take place, and consequently no support to the knee joint is obtained, and the leg tends to a condition of backward displacement with derangement of the apparatus. Fig. 18 represents a knee joint properly "stopped" at the vertical axis, as indicated by the dotted line. Fig. 19 shews an entirely "free" joint with an exaggerated position of leg, the result of using this form of joint. The "Stop" joint is also very useful in walking apparatus for Club foot and Paralysis, and is here employed at the ankle joint; its special advantage will be described in the chapters on these subjects.

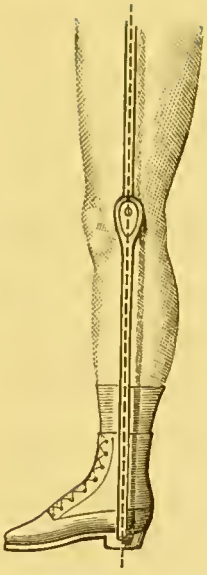


Fig. 18.

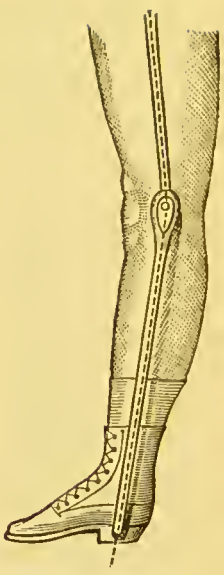


Fig. 19.

Springs.

The next important factor in all apparatus is the spring, and as the various kinds necessitate more detailed description than joints, as they rely on other portions of the apparatus for their efficiency, I shall do no more here than give a general description of the several varieties.

"Long" Spring.

The spring most ordinarily used is the "Long" or Convex Spring, Fig. 20. It is usually connected with scarpas shoes, or walking instruments, and exerts an influence at the ankle joint laterally only, so as to correct eversion or inversion, valgus or varus.

Fig. 20.

"Toe" Spring.

The "Toe" spring of scarpas shoes is formed on the same principle, with the same object, but acts directly on the transverse tarsal joint. Fig. 21.

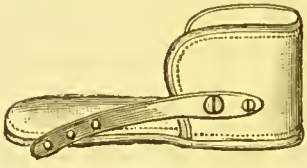


Fig. 21.

"Toe Elevating" Spring.

One of the most important springs in use is the "Toe Elevating" spring, it is generally made in the shape of the letter S, and fixed to walking apparatus. It is so constructed as to act automatically and assist locomotion in cases of partial or entire paralysis of the anterior muscles of the leg, see Fig. 22, in which the action of the spring is clearly indicated by the dotted line. A new form of toe elevating spring

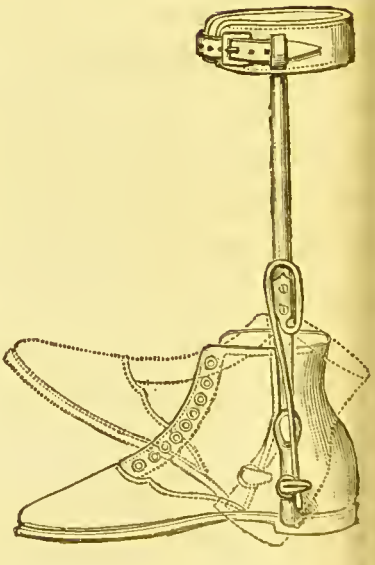


Fig. 22.

have lately introduced with great success, after the principle f the gun lock. It is retained above the ankle joint, and is ot liable to catch in the dress in the same measure as the ormer pattern.

"Gun Lock" Spring.

The "Gun Lock" spring is also very serviceable in cases of paraysis of the extensor muscles of the thigh, nd has also an automatic action, it is enerally adapted to the knee or hip joints. is usually fixed to the thigh upright of the nstrument, and connected to the lower pright of the instrument by two small vers passing over a raised fulcrum piece ted to the joint. Both this and the receding spring can be made adjustable by rack movement, enabling either a greater lesser power of extension to be maintained. Fig. 23 shews the action of this spring in the dotted ne.

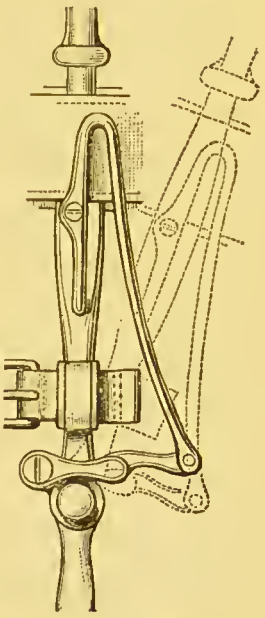


Fig. 23.

entrifugal" Spring.

The "Centrifugal" spring, is occasionally used at the hip joint, and is a more elastic form than the n lock movement. It is also useful in cases of extension of e thumb, for contraction of palmar fascia.

"Spiral" Springs.

"Spiral" springs are largely used in various forms, but more generally in connection with the knee joint.

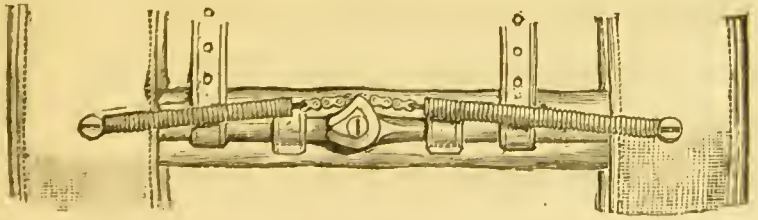


Fig. 24.

Here they are most beneficial in cases of slight dislocation, ruptured tendon, or dislocated semi-lunar cartilage. They are connected to the instrument over the knee joint by a chain, and form a very elastic and useful support. Fig. 24 illustrates this.

"Conical" Spring.

The "Conical" spring, is very serviceable in cases where a continual compression is necessary, such as hernia or prominent sternum. Here in the latter case a pressure is required which can always be maintained and still permit of free respiration. As the spring works by compression this end is easily obtained.

The Construction of Springs.

The foregoing springs which I have enumerated are all made of the best cast steel, and I much prefer this material to india-rubber. The metal if properly forged and "tempered" always keeps its degree of elasticity, and by the "rack and pinion" arrangement, its strength can either be augmented or diminished at will. This "rack" arrangement in no way interferes with the "temper," but by altering the angle or position of the spring, correspondingly alters its power. Moreover, a great feature in all steel springs exists in the compactness and small space occupied for the work they have to perform, whereas in india-rubber springs, it is essential to have a projecting lever to give the necessary point to obtain the lifting power. India-rubber, again, is susceptible to climate, and cannot be used where there is great heat. Now, steel (the small quantity used in the spring) is impervious to change, and is therefore desirable from this point alone.

General Remarks on Instruments.

Having now described the various forms of "joints" and "springs" in use, I do not think that this chapter would be complete without a reference to the appli-

cation of all appliances. Lightness with strength is *par excellence* the great point to be obtained in all instruments. There is no reason why Orthopædic Apparatus should be heavy because they are Orthopædic Apparatus, nor does it follow because they are used to cure deformities, that they in themselves should be deformities. Yet, take a great number of instruments made at the present time, and the latter part of the last sentence will apply. One of the great objections to apparatus, and I speak more particularly of those in use for the spine, and to which I have paid most careful attention, is the unsightliness caused by an ill-fitting appliance. In these days, personal appearance is as much studied as the efficiency of the apparatus, and it is essential that both should be carried out to perfection. With reference to efficiency, I always bear in mind that there is a very great distinction between *an instrument supporting the patient*, and the *patient supporting the instrument*. As to appearance, I can only say that after I have adjusted an apparatus, it would require the knowledge of its existence to detect its presence. Not only in those appliances for the spine, but in all instruments, neatness of design should be studied, and I am confident that if this be carried out, the principal objection to Orthopædic Apparatus will cease to exist.

Material used for Apparatus.

Steel should be employed invariably, and it is by the use of this metal that I am enabled to construct all my apparatus of so light a weight. For instance, an old fashioned spinal apparatus (some of which I possess) weighs from 5 to 8-lbs., and this weight is greatly increased to the wearer by its want of principle in adaptation. The weight is to a great extent caused by the use of "iron," which metal cannot

be tempered, and necessitates the use of a much greater bulk of metal to obtain the amount of support rendered by a piece of steel. My spinal apparatus weigh from $\frac{3}{4}$-lb. to $2\frac{1}{2}$-lbs., and as this gives an equal amount of support as the heavy instrument, it will readily be seen what an advantage is gained, especially in cases of delicate or weakly constitution.

Manganese Bronze.

Another metal which I am about to introduce is Manganese Bronze. It is extremely tough, and possesses the great advantage of non-corrosive properties. Unfortunately it cannot be tempered in the same manner as steel, and its use is therefore limited, but in such pieces as hip-pieces, arm-pieces, pelvic bands, etc., I am using it with good results. In the following chapters I shall enumerate the several apparatus requisite for deformities, commencing with the head and ending with the feet.

CHAPTER II.

APPARATUS FOR THE NOSE AND EARS.

In dealing with the appliances requisite for the head, I shall in this chapter deal only with those affecting the nose and ears, and which alone come under the head of Orthopædic surgery.

Apparatus for Broken Nose.

The common deformity of broken nose, resulting in great personal disfigurement and structural changes by which the septum is deflected, one or both nasal bones displaced, causing plugging of the nostril with its attendant alterations in speech and respiration, has led to the invention of various apparatus, all of which have been more or less successful. Those which I have seen most successfully used are those employed by Mr. Adams, originally designed by him, and since greatly improved by myself. After the operation of rebreaking and straightening the septum has been performed the ivory clamp Fig. 25 Pl. 1 is inserted. This clamp consists of two ivory blades AA connected at their base by a regulating screw movement B fitted with a "stop" to prevent over-screwing. The blades are made either separately, concave, or convex, according to the position of the bent septum. To insert the clamp it should be slightly opened and each blade oiled to permit easy passage into the nostril, it should then be passed upwards into the nostril half its length, and then backwards, the screw should then be tightened sufficiently

Ivory "Nose Clamp."

To Use the Clamp.

to hold the straightened septum, care being exercised not to compress. It will be seen from the shape of the blade that the lower edge will rest on the floor of the nostril, hold the septum *in sitû* and prevent displacement. A side view is given Fig. 26 Pl. 1. This clamp is very useful in cases of deflected septum only, but in the majority of cases the nasal bones are also involved.

The Nose Truss.

In conjunction with the clamp, the Nose Truss, Fig. 27 Pl. 1 is generally used and lightly applied, immediately after the operation. In severe cases this serves two purposes, firstly to keep the nasal bones in their exact position, and secondly through them to fix the clamp internally and prevent the possibility of the clamp shifting and the relapse of the septum. The appliance originally consisted of a forehead band with one lever to press on the side where the extreme curve was situate, but experience has pointed out that the old mechanical law of three points to every lever must also here be brought into use. This apparatus having only two points, viz.: the fulcrum and point of pressure, was found unserviceable, the forehead band constantly rotating for want of a point of counter-pressure. In Fig. 27 Pl. 1 the perfect apparatus is shewn. It consists of a forehead band A as fulcrum with two nasal levers B B extending on either side of the nose and terminable according to the length of the curve, these levers are fitted to the forehead band, and contain a double action "rack and pinion" movement at their upper end C C 1 posterior and anterior, and 2 lateral. At the lower end of each lever a pressure plate D D is attached by a "ball and socket" movement, which admits of ready adjustment and the maintenance of an equal pressure. These pressure plates are

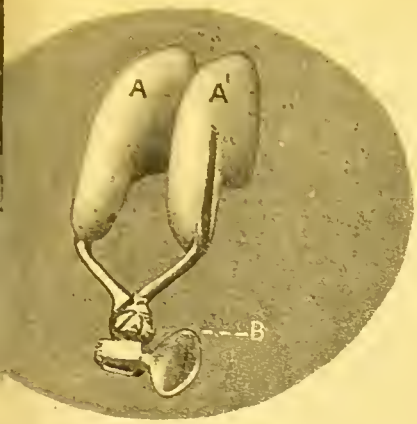


FIG. 25.

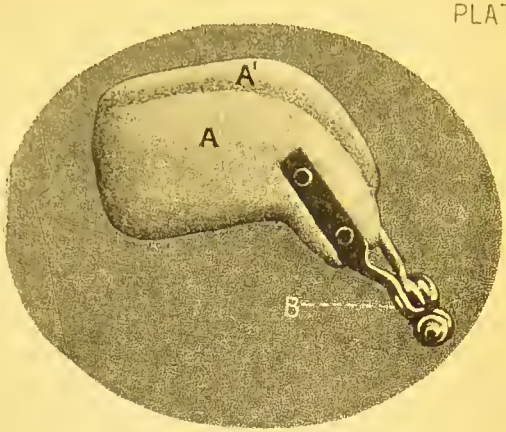


FIG. 26.

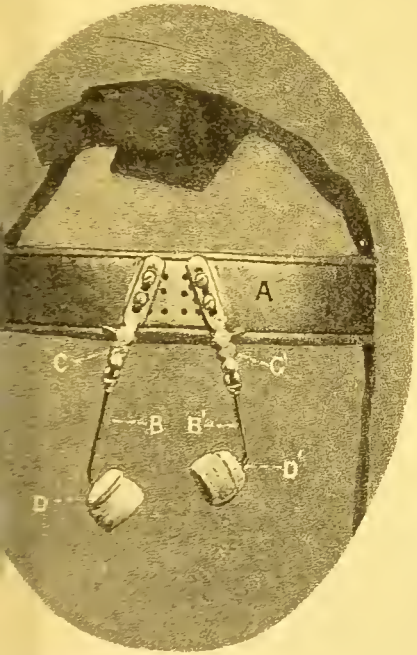


FIG. 27.

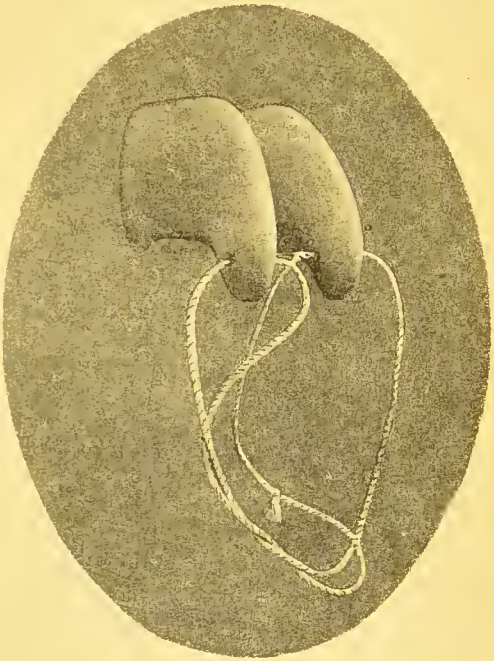


FIG. 29.

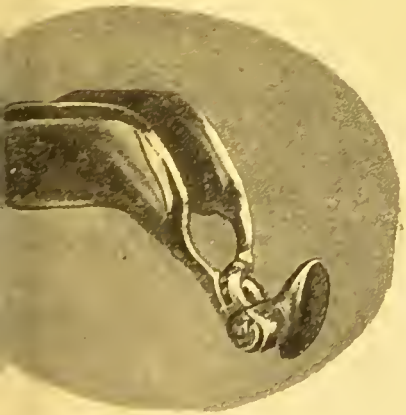


FIG. 30.

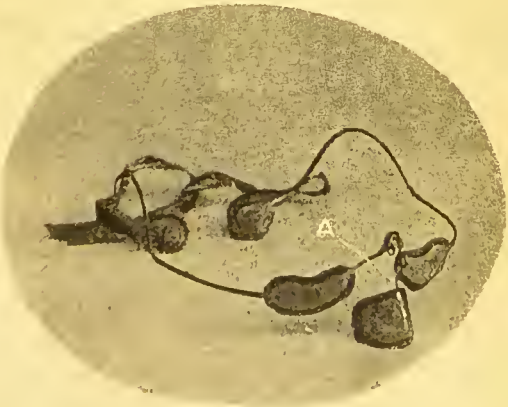


FIG. 32.

vered with a very soft piece of felt plaster, which prevents rasion of the skin and which can easily be renewed during eatment. On the forehead band where the levers are fixed a ries of screw holes are drilled, enabling a ready adjustment of e apparatus to the particular case under treatment.

pplication the Nose Truss.

In applying the instrument, the levers should be opened away from the face, and the forehead band curely fastened to the head, the levers should then be brought o position, and each tightened gradually, care must however taken that the pressure plates are not too severely applied, that abrasion of the skin may be avoided.

Fig. 28.

his nose truss is shown in use in Fig. 28, the photograph of a young lady lately under treatment. During the latter stage of treatment, and in connection with the pre-ing apparatus, the nose plugs Fig. 29 Pl. 1 are occasionally

Nose Plugs.

used either singly or together. These are formed in the same shape as the blades of the clamp. They are exceedingly useful during treatment, as it is not always desirable to have both the nostrils plugged, especially after the first 10 days, moreover the advantage and relief to the patient of one free nostril for respiration and discharge of mucous is obvious. They are inserted in the same manner as the nose clamp. The question of free respiration has often been discussed during the treatment of these cases, and various devices have been tried, one of perforating the ivory blades, another of grooving the same, but these trials have failed owing to the smallness of the apertures, which quickly become clogged with mucous and other matter. To give as much freedom in breathing as possible, it has been found in practice that the "metal" clamp Fig. 30 Plate 1 is the most perfect yet introduced. In construction and shape it follows the curves of the ivory nose clamp, but as the blades are made of steel (nickel plated) they are of much less bulk, and consequently give great freedom in the nostril.

Metal Clamp.

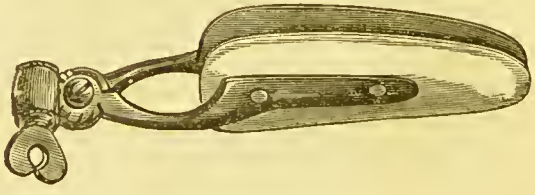


Fig. 31

In many cases it is necessary to elevate the nasal bones internally after the operation. Fig. 31 illustrates the form of clamp generally used. It is of the same construction as the nose clamp for the bent septum, but differs in the shape of the blades. The foregoing apparatus are those

Clamp Elevator.

rincipally used in cases of osseous deformity, and where peration is necessary. There are, however, a large number of rtilagenous deformities which affect the personal appearance one, and which by a perseverance in the use of an apparatus night may easily be corrected.

Spectacle Nose instrument.

The spectacle nose apparatus, Fig. 32, Pl. 1, is a light instrument for this class of cases. This is plied after the manner of a pair of spectacles taking its aring over the ears and on the bridge of the nose, from which int a light spring A extends to the tip of the nose, acting on e latter by a metal shield. This spring is "set on" conually to exert a force contrary to the direction of the deflected tilage. The instrument is light and the spring elastic so that discomfort is experienced in wear. The remaining instrument to be described in connection with the head is that for prominent ears. This deformity is generally nd in young children, and results from the "doubled up" sition so often attained when asleep, or from the careless ustment of the hat or bonnet.

Prominent ears.

Fig. 34.

Fig. 35.

Ear Spring. Fig. 33, Pl. 2, illustrates a light spring compress which keeps the ears in position and corrects their abnormal protrusion. It is composed of a light spring A to the ends of which small ear-plates are fixed B B and which are fitted over the firm cartilage of the ear. The spring is capable of adjustment at C. The instrument is nearly invisible when worn, the spring passing under the hair, and, if necessary, this can be made to cover the small plates on the ears. It is usually worn during the day-time, for at night it is liable to displacement, and discomfort may be experienced by pressure from the ear-plates. Fig 34 represents a case of prominent ears, and the application of the spring to the same is shown in Fig. 35.

CHAPTER III.

WRY NECK.

This deformity may be divided into two classes, viz.: spasmodic and rigid. In the former case the head is everted by muscular contraction of nervous or paralytic origin, and in the latter by rigid muscular contraction, sometimes congenital. The treatment and appliances for cases of nervous origin consists of exercises and passive support, and for rigid contraction tenotomy and adjustable apparatus. To commence with the cases of nervous origin it will generally be found that the head can be brought into the normal position at once, and by gentle continuous pressure, consequently a support only is required which shall be easily adapted to retain the head in position. The simplest of these supports is the blocked leather collar, Fig. 36, Pl. 2, which is adapted to take its bearing on the shoulders, and support the head and the base of the occiput, and the lower maxillary bones. This collar can also be made in poro-plastic, and is exceedingly light and cool in this material. In slight cases the preceding support is very applicable, but in cases of a spasmodic nature, more support is necessary. I have lately seen a case where the spasmodic contraction was very severe, and I adapted the following apparatus, which answered admirably.

Blocked Leather Collar.

Saddle Head Support.

Fig. 37 illustrates the appliance. It consists of a fulcrum or saddle piece A of poro-plastic or leather, taking its bearing from the shoulders, chest and back of the

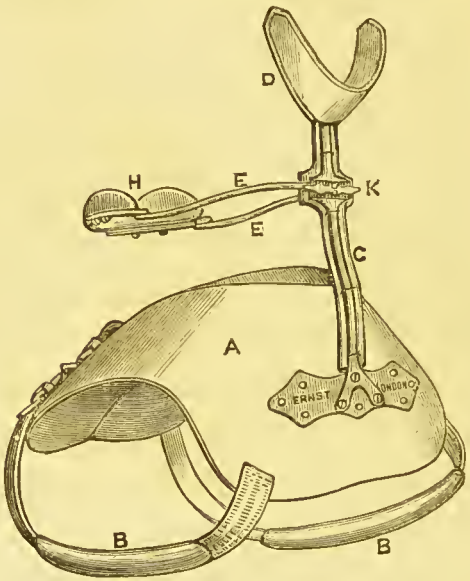


Fig. 37.

patient, and securely fastened by two axillary straps B B. A neck stem C following the median line of the spine, and extending from the saddle piece to the occiput, is attached to the occipital piece D which, with wings E E extending to the lower maxillary plate H forms the supporting points. The neck stem is capable of regulation, so as to relieve the weight of the head, in a greater or lesser degree. A novel feature of the lower maxillary wings centres in their being made detachable at K thus rendering the apparatus very easy of application, and capable of ready adjustment. The appliance is very light, and from the limited part of its construction, does not easily get out of order. Exercises to the head are also beneficial in this class of cases, and I will

ere describe an easy method, by which these can be taken
ig 38.

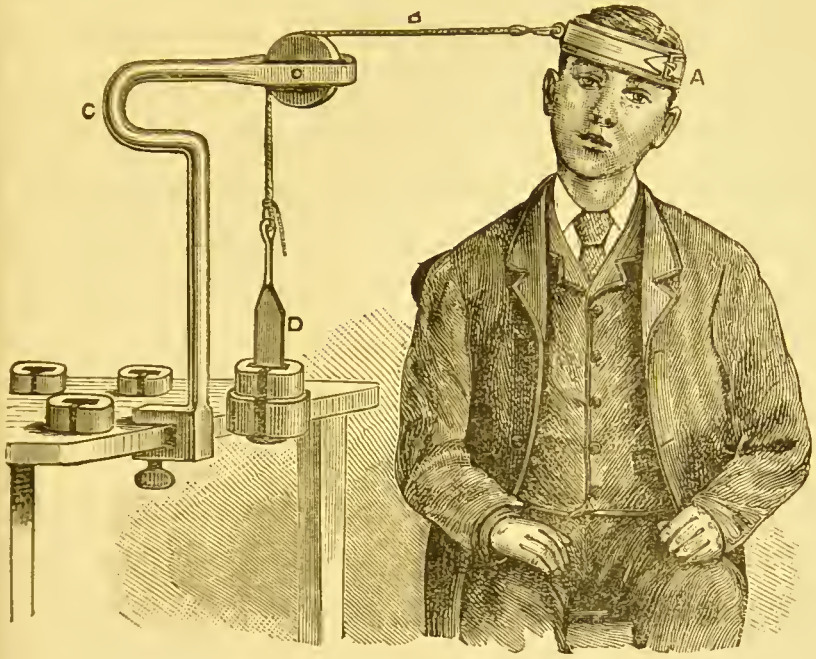


Fig. 38.

Exercising Arrangement for Wry Neck.

Let a weight stand C with pulley be attached to a table, so that the pulley should be at the same level the patient's forehead (it is best to take this exercise whilst ting); a well-padded band of leather A should then be fastened und the head, provided at one side with a metal ring. A cord B then fastened to this ring, passed over the pulley of the weight nd, and attached to the requisite weight D. The exercise is en performed by moving the head in a lateral or rotary otion according to the condition of the weakened or contracted uscles. These, of course, should be acting against the weight, receive the greater amount of exercise.

In cases of wry neck with muscular (rigid) contraction, it is cessary to resort to tenotomy, and the use of an apparatus

which shall be capable of alteration according to the progress of the case. Generally one sees that the rubber accumulator attached to a forehead band is advised, but I have not found this answer in practice. The tendon having been divided should be sufficiently stretched daily to admit of the formation of new material, consequently, the apparatus should have passive force as its principal movement. The stretching by an india-rubber band is uncertain, and may either produce a very weakened tendon, or fail to remove the entire contraction. Naturally, an appliance with passive movement becomes complicated, and I fear that this complication has led to the use of the rubber. Still, I have always seen a most perfect result with the use of the more complicated apparatus, which, after all, is easily managed.

Mr. Adams' Wry Neck Apparatus.

The apparatus of Mr. Adams, Fig. 39, Pl. 2, is the most perfect of its kind for this class of cases, and although it has been sometimes objected to, on account of its complications, which are mechanically and anatomically correct, I do not think that it can be denied, that a complicated deformity requires corresponding mechanism. Moreover, in the progress of the case, accuracy of adjustment is most essential; it is far better to have one movement too many, than one absent, which would have made the cure absolute. Moreover, an important fact is apt to be overlooked, viz.: that the two axes of the head and apparatus are different in position, and although they work in a parallel line, yet when any deviation from that line takes place, the side levers must of necessity either elongate or shorten, consequently it is essential to have the whole of the apparatus adjustable. In detailing the chief

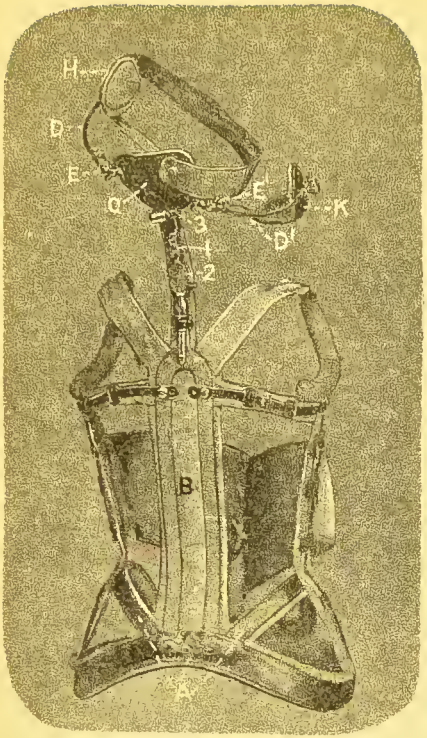


FIG. 39.

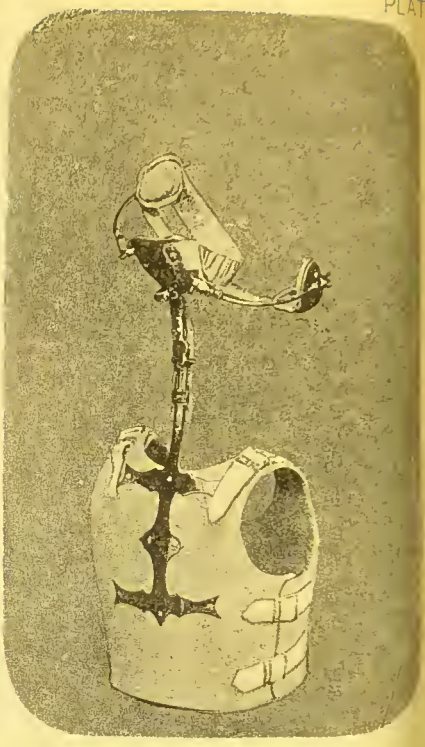


FIG. 40.

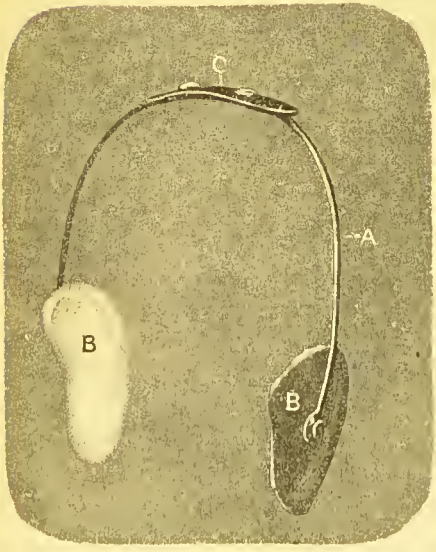


FIG. 33.

FIG. 36.

atures of the apparatus, I shall first refer to the fulcrum hich consists of a pelvic band and hip pieces A and this has een been hastily decided as unnecessary, but I think that a oment's reflection will clearly show that it is very necessary to tain a point of fixation as low as possible, and for two reasons. rstly, that the fulcrum shall be a position in an immovable rtion of the body (the nearest to the neck being the pelvis), d because the head, being attached to the spine (a flexible ries of bones) no reliance can be placed on any fixture to the inal column alone. Secondly, in all cases of torticollis a rtain amount of compensatory lateral curvature of the spine so takes place, and mechanism can therefore be adapted to the inal part of the apparatus so that a joint improvement in both ad and spine may take place simultaneously. Having now tablished the necessity of a pelvic fulcrum, I would point to the per part composed of a double back lever B which is attached to e pelvic band, and extending to one inch above the level of the gles of the scapulæ. To the top of this back lever a neck stem attached containing three rack and pinion movements. These ovements enable the head piece to be adapted to the abnor- al position of the head, and are 1 Forward and Backward Lateral and 3 Rotation. The neck stem terminates at e occiput, in a small occipital plate C to which is attached o lateral levers D D extending respectively to the forehead id chin, according to the position of the contraction. To limit of the accurate adjustment of these levers, and also to limit of the application of the apparatus, they are fitted at e occipital ends with two double-action rack and pinion ovements E E which are essential for the adaptation of the

chin and forehead plates, but which in no way effect the reduction of the head to its normal position. The chin and forehead plates H and K are also adjustable by means of a set screw, and can be moved to any position on the maxillary levers.

Application of the Apparatus.

In applying this apparatus, the side levers should first be opened out laterally to admit of the occipital plate being brought into position. The pelvic band and lower part of the apparatus should then be securely fastened; after the adaptation of the occipital plate, by the three movements in the neck stem, the side levers should be brought into position so that the head may be firmly held. The reduction of the deformity is then easily obtained by the use of the three movements, but from time to time the chin and forehead plates must be shifted. After wearing the apparatus for a fortnight, it is often advisable to take it off altogether, and entirely re-adjust the mechanism. With reference to the compensatory lateral curvature, it is advisable to correct this by lateral lace shields, connected to the spinal part of the apparatus, for a detailed description of these shields reference must be made to the chapter on Spinal apparatus. As the compensatory lateral curve varies in all cases, I have found a poro-plastic cuirass answer as an efficient fulcrum, in very slight forms. It is illustrated at Fig. 40, Pl. 2, the mechanism being the same as in the Adams' Wry Neck apparatus.

Wry Neck Apparatus with Poro-plastic Fulcrum.

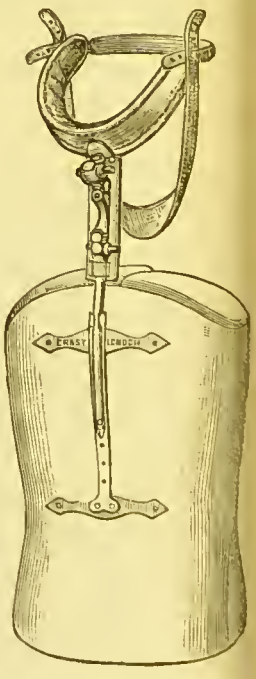


Fig. 41.

Simple Wry Neck Apparatus.

There are also different degrees of contraction in wry neck and although the preceding apparatus are ost reliable in the severe forms, I have often modified the echanism to suit the case, and dispensed with the lateral ers, substituting a head piece in their place. This I have icted Fig. 41. The three neck movements still continue t even one of these I have been able to dispense with.

CHAPTER IV.

SPINAL CURVATURE.

No greater field than that of spinal curvature is open for the improvement and invention of apparatus, and yet how slow is the general progress made in this direction. With the exception of Sayre's Plaster of Paris jacket, introduced nine years ago, little has been done to alter the form of the spinal apparatus, and I frequently see patients wearing instruments, and but recently made, which were in vogue thirty or forty years back. I speak from a constant experience of cases, which I see with appliances well meriting the consideration of the Inquisition. Why should these instruments be made? Why should patients suffer from their use? Simply from ignorance—ignorance on the part of the maker, and ignorance of the patient as to the nature of a well-fitting apparatus. I constantly see these cases with appliances having no fulcrum, no point of counter pressure, and simply hanging to the patient by the shoulder-straps. My objection to weight, although an important consideration, is not so great as my objection to want of principle. Take for instance the Plaster of Paris jacket for an adult. I have removed one weighing 14lbs., and this has not been a serious cause of complaint because the principle of a mechanical law has been carried out and a great support derived by reason of the Plaster of Paris jacket taking its bearing on the pelvis, and

ansmitting the weight of the trunk to this base, but in an
-fitting support there is no fulcrum and the instrument simply
ags down the patient. A great deal of misapprehension
ists as to steel spinal apparatus, and although I do not recom-
end these as the *only form* of support for the spine, I wish to
plain the true principle on which each apparatus should be
nstructed, believing that if the principle of these instruments
as understood, they would be rightly appreciated, as they
ould be. I shall endeavour to show that there is at present
reason why each apparatus may not be adjusted in every
se in such a manner as to be thoroughly efficient and perfectly
mfortable to the wearer. That there exists a necessity for
me support to the spine in all cases of spinal curvature, is, I
ink, generally admitted; the question remains: what form is
e best? There is no kind of appliance which can be said to
universal; cases apparently similar, materially differ in point
detail. In many instances where a felt jacket has been
plied, it has proved unwearable, and a steel apparatus has
en satisfactorily adjusted in its place, and *vice versâ*. This,
om no fault in the original application. The explanation is
mewhat difficult, but may be principally attributed to the
idiosyncracy of the patient. We possess at present
two classes of spinal apparatus, viz.: mechanical
d circumferential. By the former we mean those supports
ade of steel and taking their bearings from various localities
the body, and by the latter we mean those supports made
poro-plastic or leather, etc., in which the whole support is so
ually diffused over the entire body, as not to be felt in one
rticular spot more than another. Therefore, in some cases,

Spinal Apparatus classified.

steel supports are unbearable, because localized pressure cannot be tolerated and on the other hand a circumferential pressure causes too much restraint. The decision, therefore, as to which kind of apparatus can be employed is, in many cases, only the result of experience. Steel supports are divided again into two classes, active and passive. Those used where improvement and cure will take place, and those used merely to give support, and relieve pain or pressure. The poro-plastic jacket is purely a passive support, and I shall describe its particular points and its advantages over Plaster of Paris later on. Spinal apparatus in themselves are insufficient for the relief and cure of Spinal curvature and must be used in conjunction with gymnastic exercises of a specific nature, to follow up and preserve that improvement which is gained by muscular development.

Classification of Apparatus for different cases.

There are three classes of cases requiring different appliances. *Firstly*, those cases of commencing curvature between the ages of 8 and 18 years, especially occurring in young girls; here gymnastic exercises are absolutely necessary, and an apparatus which can be readily adjusted, so that the improvement may be easily followed up by the support. *Secondly*, those cases of advanced curvature, between the ages of 18 and 25 years in which no previous treatment has been employed; here again, gymnastic exercises are useful, but as only a partial improvement can take place, a less adjustable apparatus is necessary. *Thirdly*, those cases of extreme curvature in advanced life; here gymnastic exercises are useless, and a passive support simply required. I will now describe the formation of a spinal apparatus. Its essentials are:

Essentials of a Spinal Apparatus.

Firstly, that it shall be mechanically adapted to the

quirements of the case. *Secondly*, that it shall be anatomically rrect. *Thirdly*, that it shall fit accurately. *Fourthly*, that it shall be as light as possible. To adapt a spinal apparatus mechanically correct, it is necessary to obtain three points in the fitting of the instrument, ., the fulcrum, the point of counter-pressure, and point of essure or support. These are established respectively in the lvic band, arm pieces, and lateral plates or shields. The lvic band is the most important feature of the spinal apparatus, d in this, a great alteration has been made by myself ich has entirely changed the form of these appliances, and tained a great success in their usage. The old form of lvic band took its bearing much below the sacrum, the idea ing that the back lever might, and should be, as long as ssible, for it was argued "the greater the length the greater e support," but applied to this form of lever it is erroneous. ere are two distinct kinds of levers, those for support, and se for elevation. In the latter, the familiar illustration of a ourer prizing a heavy weight from the ground, necessitates e use of a long lever to obtain the necessary lifting power, but the case of support to the spine, we have, as it were, to hore up" and resist, and this can be most effectually attained a short and rigid lever. I have therefore constructed all my lvic bands in a crescent form at the back, bringing this part high as possible on the sacrum. This is shewn in the eleton wood cut, Fig. 42.

Mechanical daptation of Spinal pparatus.

The band encircles the pelvis at the sides of the body almost e inch above the heads of the great trochanters, and in front out half an inch below the anterior superior spinous process

of the ilium. To render the fulcrum more stable, I connect the front and back of the band by hip pieces *i i* taking an equal bearing on the crests of the iliæ, by this means obtaining a most solid basis. The next point to be obtained is that of counter pressure. This should come from the axillæ. Crutches *e e* with arm pieces *a a* are attached to the pelvic band in the same axis as the body, and fitted at right angles to the pelvic band. In the illustration it will be seen that two levers *h h* cross in front of the apparatus, and are connected with a sternal plate *g*. This idea originated with Dr. Dick, and is a great assistance as an additional counter pressure. It has not been generally followed up in the adaptation of spinal apparatus, although the idea is mechanically correct, and considerably relieves the pressure from the arm pieces.

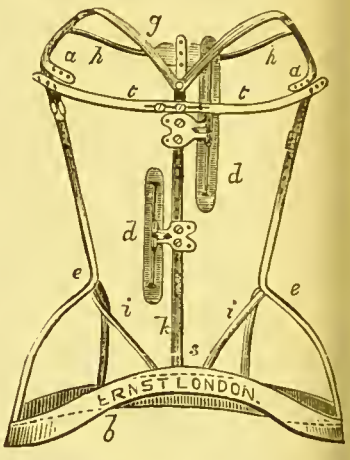


Fig. 42.

(I would here draw attention to the adaptation and formation of the arm-pieces. An erroneous idea exists that the weight of the shoulders can be removed, and the spine elongated by a high crutch. This is impossible, the shoulder joint has so much mobility that any upward extension merely increases the axillary pressure, tends greatly to deform the appearance of the patient, and causes unlimited discomfort, without in the slightest degree affecting the spinal curvature. The real adaptation of the crutch is simply to afford a comfortable rest at the axillæ, its more important bearing being in the front to obtain the exact

bint of counter-pressure. On examining
d instruments it will be seen that the
m pieces are made in the shape of a
escent, Fig. 43, the result being, that in
ear, great impediment to the free motion of
e arm is experienced, with considerable
essure on the pectoral muscle and abrasion
the skin. If we examine the dissection of the shoulder joint
shall find it represents a triangle, with the top of the shoulder
the apex, and the axilla as the base, therefore the metal
m piece should have the form of the base, and one side of
triangle Fig. 44. All arm pieces fitted in
is manner give the mechanical point of
unter-pressure in front, and are extremely
mfortable in wear. One of the greatest
provements which I have made in the
rmation of the arm piece consists of the
plication of the spring in an elliptical form.
his is illustrated, Fig. 45, and the special
tion is shewn by the dotted line.
his arm piece is particularly useful to
ose whose occupation is of a sedentary
ture, as it yields to every movement
a forward direction, still maintaining
efficient point of counter-pressure.)
he back lever *k* is then attached
the centre of the pelvic band, and
ould reach to the centre of the scapulæ. With the excep-
n of the instrument with movable levers, it is usually

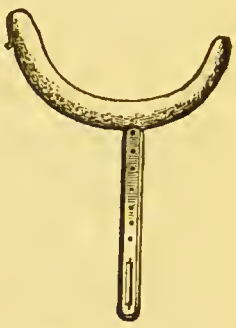


Fig. 43.

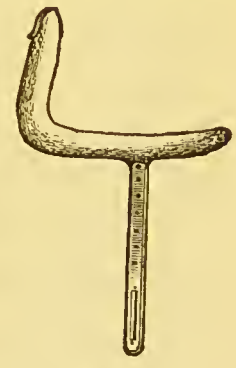


Fig. 44.

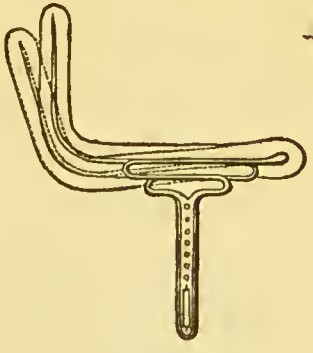


Fig. 45.

made in the double form, *i.e.*, a flat piece of steel connected at the top, and passing along either side of the spine, by this method all pressure on the spinous processes of the e rtebræ is avoided which occasionally follows the use of the single stem. To this lever are attached either the "spring plate," or "laced-shield" *d d* and these form the point of support or pressure, but previously the back lever should be joined to the upper part of the crutches by cross-bars *t t*. The foregoing are the essentials of a mechanical support. The anatomical points are easily understood, and have been explained in conjunction with the mechanical. With reference to the fitting this is purely a matter of skill and experience, and I hold that the greatest success is obtained where an apparatus can be so perfectly adjusted as to be invisible through the dress. This is my invariable result, and without the sacrifice of utility. Lightness is my fourth essential, and this I have already demonstrated. Having described the construction of a spinal instrument, I shall now enumerate the several apparatus for :—

A. Lateral curvature of the spine.
B. Suitable exercising apparatus for the same.
C. Posterior curvature of the spine.
D. Potts' disease of the spine.

A. Apparatus for Lateral Curvature of the Spine.

Adjustable Spinal Apparatus with Movable Levers.

Fig. 46 Pl. 3 illustrates the adjustable spinal apparatus especially suitable for cases of commencing lateral curvature, and also in those cases of advanced curvature, where no previous treatment has been adopted. This appliance is essentially for the use of the surgeon, and in no case

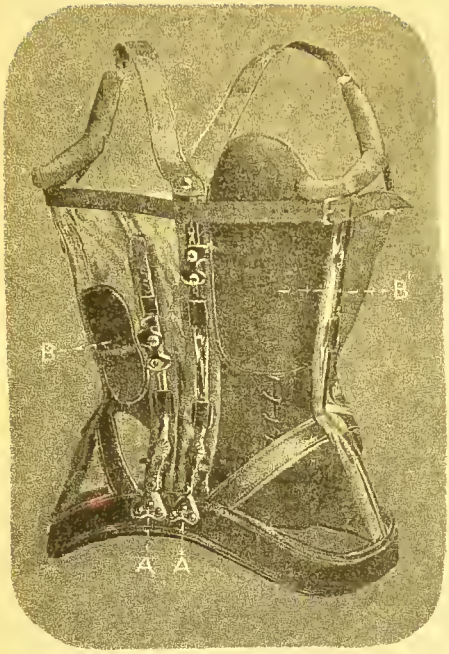


FIG. 46.

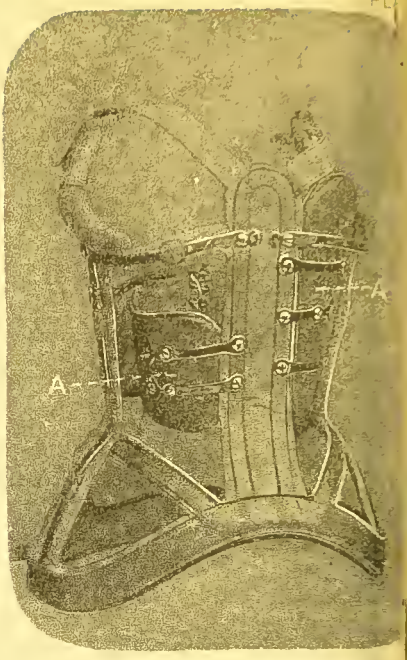


FIG. 48.

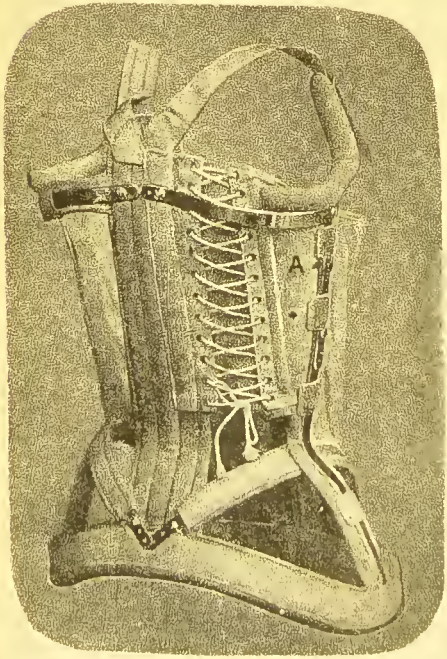


FIG. 47.

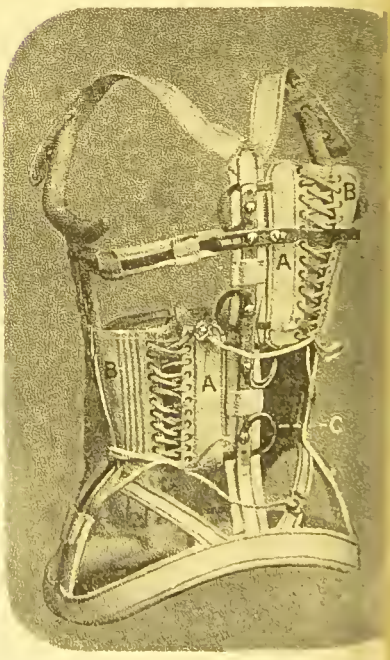


FIG. 49.

should it be given into inexperienced hands. Harm to the patient will result from overscrewing, and the apparatus will be entirely displaced by force. It must be remembered that the movements are placed *to enable the ready adjustment of the instrument to any improvement* obtained by exercise, and *not to force the curvature into position.* Its distinctive character is the movable levers A A which are attached to the pelvic band, about ¾ of an inch on either side of the spinal column, thus avoiding any pressure on the spinous processes of the vertebræ. Each lever is fitted with a lateral and forward rack-and-pinion movement at its base, and it will be observed what great advantage is here offered to the movements by the crescent shaped pelvic band. The upper movement of the racks, viz., the lateral, is brought opposite the lower lumbar vertebræ, and thus the lever motion springs from the same centre as the articulation of the spine to the sacrum. Lateral plates with swivel movements B B are adjusted to the back lever, corresponding to the nature and degree of the curvature. The entire front of the apparatus is fitted with "stay-portions," which are either laced or fastened by elastic bands; no other corset is necessary. These render the support entire, at the same time permitting free respiration and development. In this and every apparatus, arrangement is made for growth and enlargement, the instrument being adjustable by lengthening pieces.

Application of the Apparatus.

In applying this apparatus it is advisable to open each lever, so that the pelvic band may be properly adjusted and the fronts securely fastened, the levers and plates can then be brought into position. This is done by advancing the plates, firstly, by the lower movement, this brings the plate

easily in apposition with the body at the back. The lateral movement is then brought into use, and the plate adjusted at the side sufficiently tight to exert the requisite amount of pressure. This is the most powerful apparatus of its kind, and consequently the heaviest. This weight may not be detrimental to a robust subject, yet there is a large class of constitutionally weak patients where a lighter support is essential.

Adaptable "Laced-Shield" Spinal Apparatus.

Fig. 47 Pl. 3 represents a very light apparatus called the "Laced-Shield" Apparatus, the special feature being the way in which the support is derived. The form of appliance is the same as the preceding figure but the adaptable part consists of strong laced shields A attached to the crutches and back lever respectively. According to the nature of the case, these are arranged for either single or double curvature. A moderate pressure is obtained by the shield, and as the curvature is improved the laced portion is correspondingly tightened. On account of the readiness by which re-adjustment is obtained this instrument is a general favourite, and largely used; moreover, having no rack mechanism there is nothing to get out of order. In cases of single curvature it is necessary to attach the shield to an "angular lever" fixed to the crutch, situated on the side of the curvature. This lever extends the laced-shield beyond the axis of the body, and consequently covers a much larger area of the curve, and gives greater support. I have found this support invaluable in severe cases of patients of advanced years, and I have successfully adapted several ladies between the ages of 60 and 80 years.

Adaptation of the Apparatus for Adult Life.

I have been obliged to modify the construction in the following manner, in the arm pieces or the

part which is the counter pressure I have removed the steel, and substituted softly padded leather; and the hip pieces of metal have also given place to leather. As a rule, the cases I have met with at this age are in feeble health, and owing to the severity of the curvature, very sensitive to hard pressure engendered by the use of steel. As the leather adapts itself to the bony prominence of the iliæ, any abrasion of the skin is thus avoided. In all cases the apparatus has been worn with great comfort.

In cases where severe rotation of the vertebræ exists, slight improvement only will take place, consequently it is but necessary to have a certain amount of pressure from the instrument. The spring force is most suitable in these cases, and is very practically carried into effect in the following apparatus.

Mr. Adams' Retentive Spring Plate Spinal Apparatus.

Fig. 48 Pl. 33 illustrates the retentive spring plate spinal apparatus of Mr. Adams. The usual fulcrum and point of counter pressure form the base for the attachment of the mechanism. The essential point is centred in the spring plates A A which are made of steel entirely, and which are carefully hammered to fit the projecting sides. The apparatus can be adapted for both single and double curvature. These plates are softly padded, and as they are made to take an equal bearing on the side, the pressure and support is evenly distributed and the instrument easily worn by the patient. The plate is attached to the back lever by springs, which are "set on" in such a manner as to produce direct counter rotary movement. The requisite pressure is adapted in the first instance, and as this should be at a slightly greater angle than the curvature, it is apparent that when the

apparatus is worn, a constant pressure is maintained. This is an invaluable appliance for patients who live away from the surgeon, and can only make periodical visits. Exercise and gymnastic movements may continue, and the apparatus still be self adjusting, until the spring power ceases to give pressure from the improved condition of the curvature. This apparatus is very supporting, and consequently somewhat rigid, and cannot therefore be borne by all. As an equally efficient appliance and also suitable for lateral curvature with rotation, Fig. 49, Pl. 3 illustrates an instrument which is much used. It is a combination of the spring plate of Adams and the laced-shield apparatus. The difference exists in the application of the spring plate. In Adams' instrument the metal covers the whole of the side, whereas in this appliance the spring plates A A merely act on the transverse processes of the spine, and the laced-shields B B support the lateral deformity. This apparatus is so very light, weighing less than 1½-lb., that it is very generally adopted, not only for lateral curvature, but in cases of general spinal weakness. It is of course modified to the requirements of each case. It differs considerably from the spring plate instrument in the construction of the spring which in that form of apparatus is straight, and gives a powerful action, but in the combined apparatus the spring C is twisted in the form of a "C," thereby greatly increasing the length of the spring, and consequently giving greater elasticity to the whole support.

Combined Spring Plate and Laced-Shield Apparatus.

Fig. 50 represents Dr. Little's Spinal Apparatus which has an important invention in the constructio

Dr. Little's Spinal Apparatus.

of the counter-resisting arm pieces, which are very accurately adjusted by a regulating screw arrangement at the top of the back lever. This is shewn Fig. 51 and is composed of a long screw E which terminates the top of the back lever A A over this screw passes a centre piece connecting the arm pieces C C and in which a slot is cut to receive a revolving nut. The edges of this nut are milled to facilitate easy adjustment; not only by this means can the arm pieces be readily adapted and easily altered to increased growth, but they afford a greater degree of freedom as the screw connection forms a swivel movement, and sides crutches can be dispensed with.

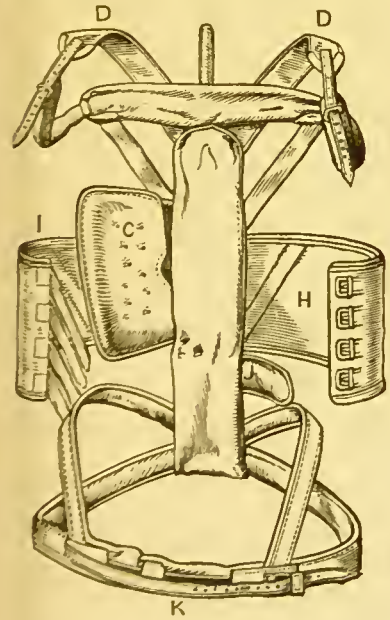


Fig 50.

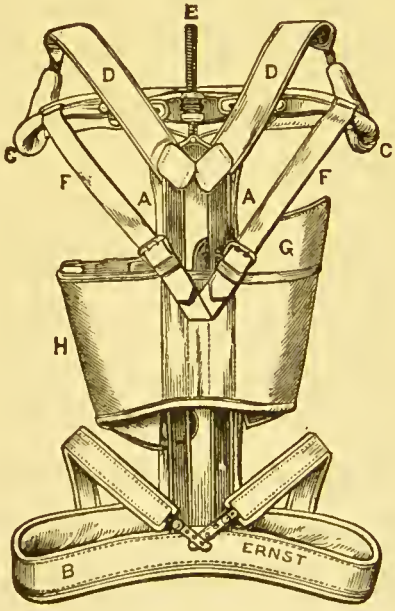


Fig. 51.

To regulate this movement it has been found necessary to attach transverse straps to the back lever; the pressure on the curvature is arranged for by two lateral plates G J which are attached to the back lever; extra support being given to the patient by the belt H.

As far as the usual mechanism is concerned, the preceding figures give a general idea of the form of steel spinal apparatus now in use. Many modifications are required to be made, but it would be quite impossible to illustrate all.

Dr. Dick's Spinal Apparatus

There is, however, an instrument which as far as mechanical construction is concerned, is absolutely perfect, and in many cases where it has been used the result has been extremely beneficial. I refer to Dr. Dick's Spinal Apparatus Fig. 52

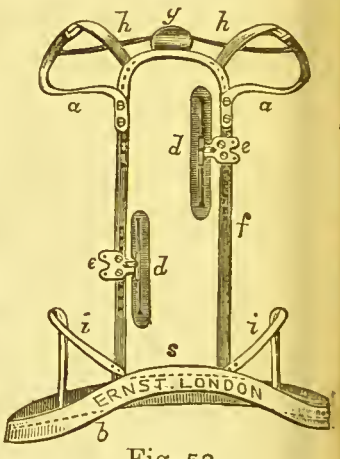


Fig. 52.

This instrument is formed with the usual pelvic band and hip-pieces *b s i i* with the counter-pressure taken from the arm pieces *a a* and the auxiliary sternal plate *g* connected to the arm pieces by the transverse sternal bars *h h*. The marked feature of this apparatus lies in the construction of the back lever *f* which is unusually broad, and the mechanism of the pressure plates. The diagram represents an apparatus suitable for relieving double lateral curvature of the spine. The idea carried into effect is, viz., that of curing lateral curvature by attacking the spine itself, without pressure on the ribs. The rack pieces *e e* are attached to the back lever, according to the position of the curvature, and the plates *d d* cover the transverse processes of the spinal column. The mechanism consists of an advancing movement, which is regulated by a rack arrangement. It is, of course, not intended that this should be used with force, the object of the adjustin

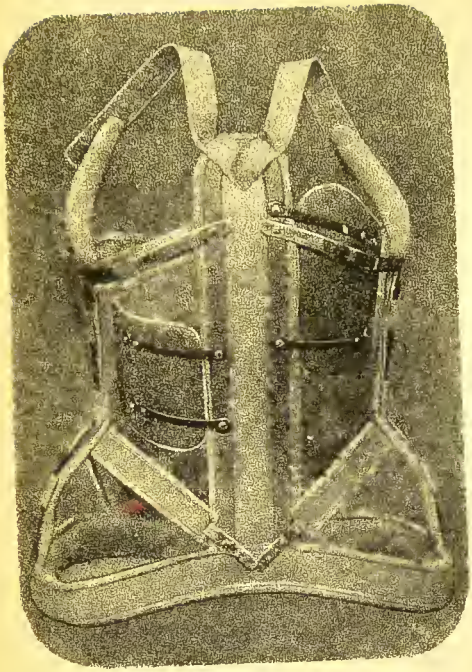


FIG. 54.

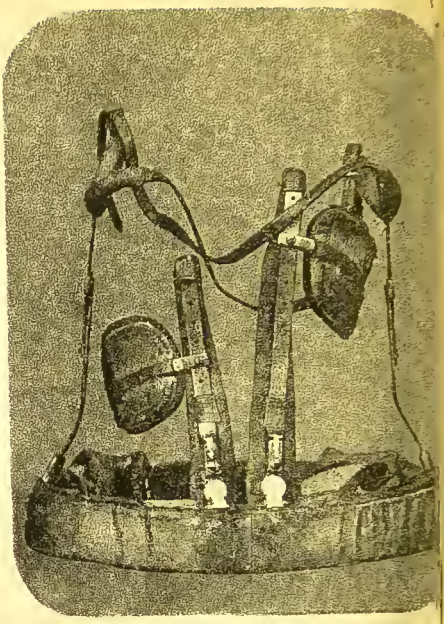


FIG. 53.

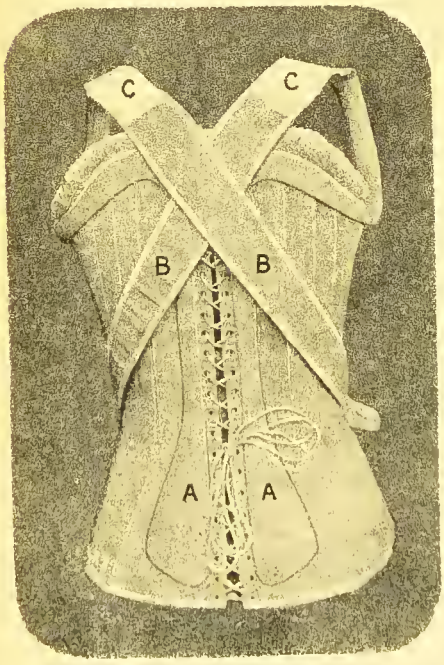


FIG. 55.

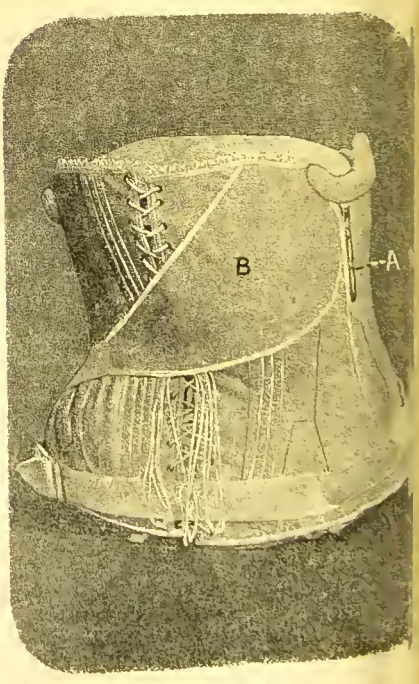


FIG. 56.

iechanism is purely to enable the very accurate application of he exact amount of pressure required. Whilst on the subject of steel instruments, I cannot refrain from illustrating a spinal apparatus, Fig. 53, Pl. 4, which I have just received from a patient, and for which I have substituted one of my own Fig. 54, Pl. 4. It is unnecessary for ie to enter into any comparative description of either, as the lustrations so fully shew the difference in construction. I ould, however, mention that the weight of the old apparatus is -lbs., and of mine, 2-lbs. 3-ozs.

Comparison in the Construction of Supports.

Spinal Stays.

Spinal stays form an important element in the treatment of spinal curvature, and are used at two istinct stages; firstly, in those cases where very slight curature is noticed, and steel supports are not requisite; and econdly, after the use of the steel apparatus as a medium etween the great support derived from the use of steel and the eturn to ordinary corsets. Fig. 55 Pl. 4 illustrates the spinal stays recommended and designed by Mr. Adams, which will be found invaluable in these two stages. In ie first stage they are generally used in conjunction with ymnastic exercises, but as a support alone to a weakened pine, they are found very beneficial. The essentiality in the hape of the corset, is its great depth and height. The steel upports A A which are attached to the back, give an equal upport on either side of the spine, taking their bearing on the acrum, and extending to the centre of the scapulæ; the upper xtremities are continued in the form of shoulder straps B B ith elastic insertions C C which in no way impede free action f the arm, but by bracing the upper part of tho body back to

Mr. Adams' Spinal Stays.

the steels give a most perfect support to the spine. The shoulder straps cross at the back, and from their position the stays are much used in cases of round shoulders and stooping. In slight cases of curvature the spinal stays may not always be sufficient support for the entire day, or occasionally when the patient may have to undergo any greater fatigue than usual. As an adjunct to wear in turn with the

Light Steel Frame Support.

stays, I would recommend the light steel frame support, Fig. 57, Pl. 5. In cases of muscular debility and weak spine this can easily be worn with the ordinary corset over. In adults of advanced years, where slight support

Spinal Stays for Adult Life.

is alone needed, the spinal stays, Fig. 56, Pl. 4, will be found very suitable. In construction they are similar to the preceding stays already described, but in place of the steels at back a light crutch A is attached to either side of the stays, and a broad strap B supporting the curvature is fastened transversely to the side opposite the curve. In both the preceding figures I sometimes insert elastic through the entire depth of the front to favor development and easy respiration.

The treatment of spinal curvature by suspension and the Plaster of Paris jacket has, of late years, been largely carried out with more or less success; but as the Plaster of Paris possesses several unpleasant features, in 1878, at the request of several leading

The Poro-Plastic Jacket.

Surgeons, I perfected and introduced the Poro-plastic Jacket. It is not my intention to enter into the merits or demerits of the treatment of spinal curvature by Plaster of Paris. That is the Surgeon's province, but, as to *material*, I think I am justified in pointing out the advantages which I think the poro-plastic possesses. The poro-plastic jacket

s composed of felt saturated with various gums, which, fter a baking process, is immersed in an acid bath, roducing a hard material equal to the rigidity of Plaster f Paris; and which on the application of heat becomes pliable nd easily moulded to any shape, the latter being retained on ooling. Although the poro-plastic is adaptable yet it will not tretch sufficiently to enable one to take a sheet of the material, nd mould a jacket from the same. It is essential that the felt hould first be approximately adjusted to the required shape, nd then stiffened with the solution of gums. For this purpose , large number of blocks or moulds are used in the manufacture, nd on these the jackets are first made. For all ordinary cases is sufficient to take measurements; but in severe cases both f lateral and angular curvature, it is always necessary to take , cast of the deformity, or else very accurate "sets" in lead. he advantages possessed by the poro-plastic are as follows:—

Advantages of the Poro-Plastic Jacket.

1. Lightness and porosity.
2. Ease of application.
3. Facility for the Attachment of steel supports in severe cases.
4. *Immediate* fixation *before* releasing the patient from suspension.
5. By leaving certain portions of the jacket free from the harden- ng solution, pressure on prominent bones is avoided.
6. The same jacket is capable of re-application as often as neces- ary; therefore economy.
7. Durability; the same jacket lasting fully eighteen months.
8. Capability of removal for ablution or gymnastic exercises.

Application of Poro-Plastic Jacket.

The following method if carefully carried out, will ensure success in the application of all jackets. The appliances required are the usual suspension

apparatus and a heating apparatus. With reference to the former, I will describe some important improvements I have made under the heading of "exercising apparatus." The heating apparatus can be of any suitable arrangement whereby the requisite temperature may be obtained. Fig. 58 illustrates that generally used by myself. Having procured the jacket, the first thing to arrange is that the heating apparatus shall be at the required temperature; this should vary from 160° to 180° Fahr. When this has been registered, the jacket should be inserted, and during the softening of the poro-plastic, which occupies from three to five minutes, according to the size, the patient may be suspended. (It will be found advisable to place a small dish of water in the heating apparatus, as a moist heat softens better than a dry one.) The patient should be wearing an ordinary close-fitting merino vest usually procurable at all hosiers, and which I find better than the woollen Sayre's vest. Two or three double-tailed bandages are necessary, and one or two firm pads. The jacket having been ascertained to be quite soft, should now be removed from the heating apparatus, and quickly applied to the patient and buckled in front, care being taken that the soft parts for the hips, mammæ and prominent spine (if any) correspond. The jacket is then worked with the hand into the depressions and irregularities of the

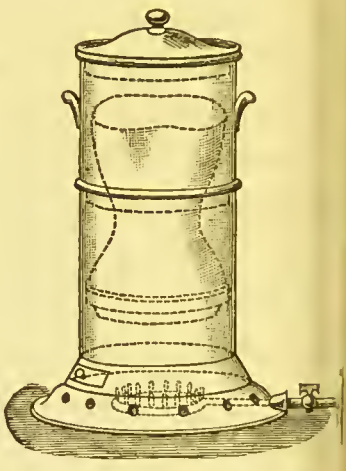


Fig. 58.

body, and retained there by the bandage, which should be tightly rolled round the patient. Each hand unrolling one tail of the bandage, and crossing and re-crossing until the length is exhausted. Should there be any considerable cavity at any part of the body, place a pad over that cavity, and then bandage over the pad; by this means the jacket is pressed into the hollow space. In five minutes from the first application, the jacket will have set quite hard, and the patient can be released from suspension. The bandages are then removed, and the jacket completed by lacing; but before doing this, it is desirable to see that the jacket is the right height under the arms; if too high, a piece can be easily removed by a penknife. In comparing the poro-plastic jacket with the Plaster of Paris jacket, the fact is often overlooked that they are both used in the same plan of treatment, and that the difference only exists in the material. That the poro-plastic possesses advantages over the Plaster of Paris cannot, I think, be denied; take for instance that of "the fixation of the spine, before release from suspension," and that within five minutes (at the outside) from the commencement of application. Plaster of Paris cannot do this, the jacket cannot even be applied in this time, and even after it has been finished it is not hard. Consequently, a greater or less degree of sinking must take place, added to this, it is not thoroughly dry under 12 hours. Then again, the facility with which the jacket can be removed for ablution and gymnastic exercises, and in cases of Pott's disease for an occasional examination of the seat of disease, is an advantage which cannot be disputed. Again the advantage of a frequent re-adaptation of the jacket is obvious, especially in a case of

lateral curvature where great improvement is made, and my experience in this point proves that the oftener the jacket is re-moulded the harder it gets. There is no need for me to enumerate each advantage in turn, the superiority of poro-plastic over Plaster of Paris is obvious, and I cannot refrain from thinking that if the application and merits of the two materials are carefully weighed, the balance will be considerably in favour of the poro-plastic. The poro-plastic jacket is illustrated in a front view, Fig. 59, Pl. 5, and is shewn applied to a slight case of lateral curvature, Fig. 60.

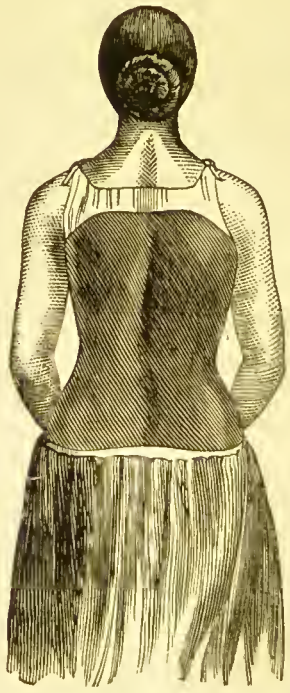


Fig. 60.

In severer cases, it is necessary to have steel attachments and this application is illustrated, Fig. 61, Pl. 5.

FIG. 57.

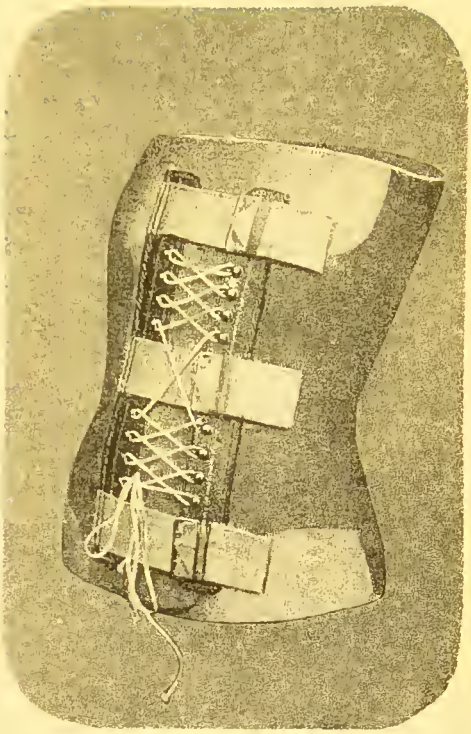


FIG. 59.

FIG 61.

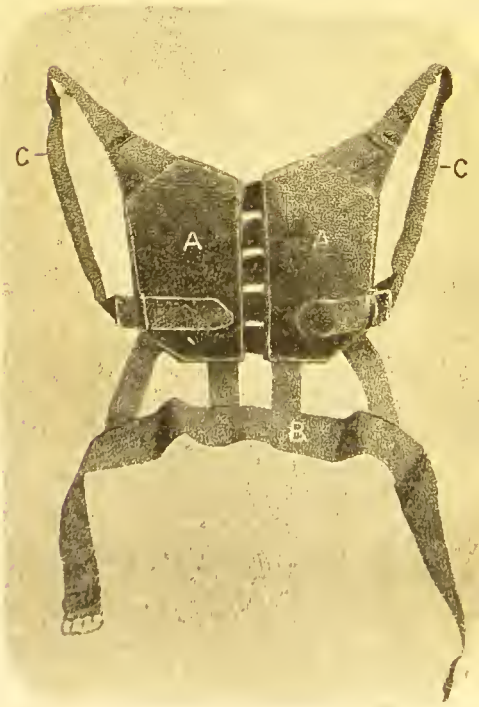


FIG. 62.

B. Exercising Apparatus for Lateral Curvature.

Remarks on Exercising Apparatus.

The necessity for gymnastic movements in the treatment of spinal curvature, has been so much insisted on by medical men of late years, that principally at the suggestion of Mr. Adams, I have been led to devise simple apparatus by which the patients can take the necessary exercises at home. The advantages of this plan are very considerable, when one considers the class of cases generally under treatment, and where the walk or ride to and from the Gymnasium, and the necessity of doing the exercise in a prescribed time, merely tends to exhaust instead of strengthen the patient. Moreover by having the exercising apparatus fixed in the bed-room or adjoining room, the exercises can be taken in the early morning, the patient wearing little clothing, thereby giving greater freedom in action and a greater muscular development. Calisthenics and drilling, in which the majority of exercises are taken on the feet for a long period, are not as a rule advised for a commencing case of lateral curvature. It is well known that when lateral deviation of the spinal column takes place, it is (without treatment) greatly accelerated by the weight of the head, and consequently it is so necessary to remove this superabundant weight as often as possible during the cure and relief of spinal affections. This is very aptly illustrated by the suspension apparatus of Sayre being attached to the head alone, during self-suspension, and during which exercise, a direct extension of the spinal column takes place. The exercises now in use are divided into two classes, viz., horizontal and vertical. Of the former class, the simplest yet devised is that illustrated Fig. 63, Pl. 6.

Horizontal Exercising Plane.

This Exercising Plane was introduced into the treatment of spinal curvature by Mr. Adams, for whom I designed it, in the year 1882, and has been used with marked success in many cases, which were previously at a standstill, with vertical exercises only. Not only in forms of lateral curvature is this plane so useful, but also in those cases of angular curvature, after consolidation of the vertebræ has taken place, and where the muscular system has become generally weakened by enforced recumbency; also in posterior curvature or round shoulders, and any spinal muscular debility, much benefit may be derived from the careful use of this plane. In round shoulders, especially, cases can almost be entirely cured by this exercise; the deformity exists generally on or above the axillary level, rendering the use of any apparatus of little avail. This plane is a modification of Shaw's and Amesbury's, and differs considerably in the counter-resisting force. In the latter planes this consisted of weights (usually shot in small bags,) drawn over pulleys. In my modification, the counter-resisting force is centred in an india-rubber accumulator. The great advantage of the latter over the former is this: the shot or weight, when raised from the ground, immediately brings the whole force into use, and therefore requires the expenditure of great muscular effort at the commencement of the exercise, whereas the tension of the india-rubber accumulator is but slight at first and increases gradually as the extension is made. Another improvement over the old method consists in the handles, which are placed at the head of the couch, these when grasped enable the patient to maintain a steady and continuous movement very different to

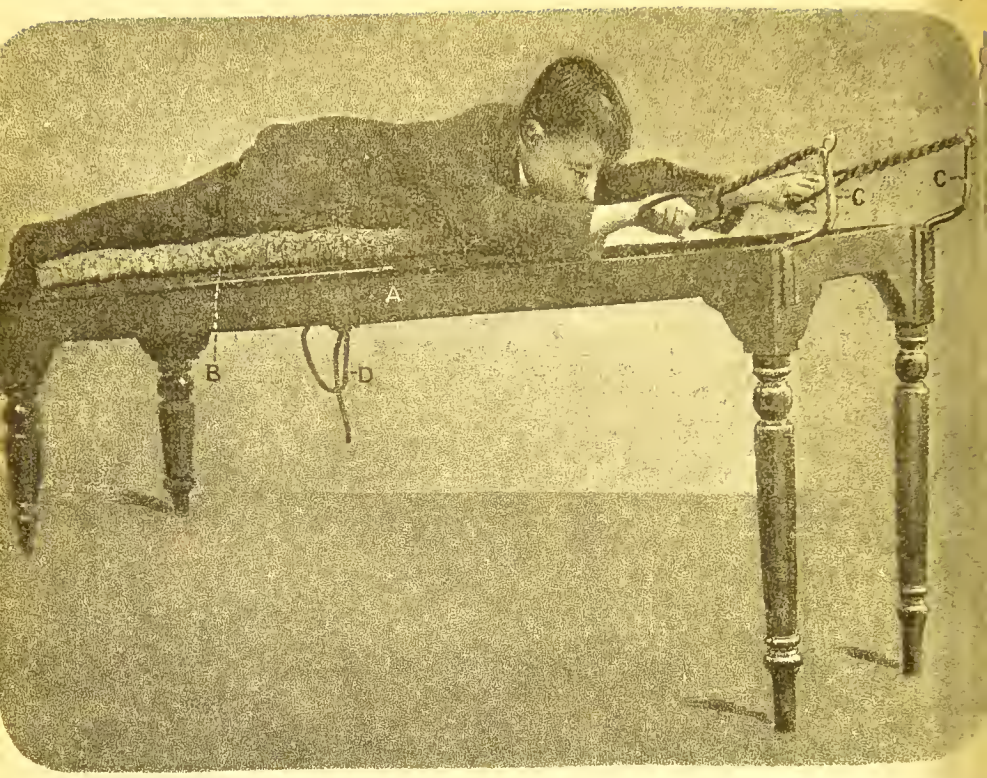


FIG 63.

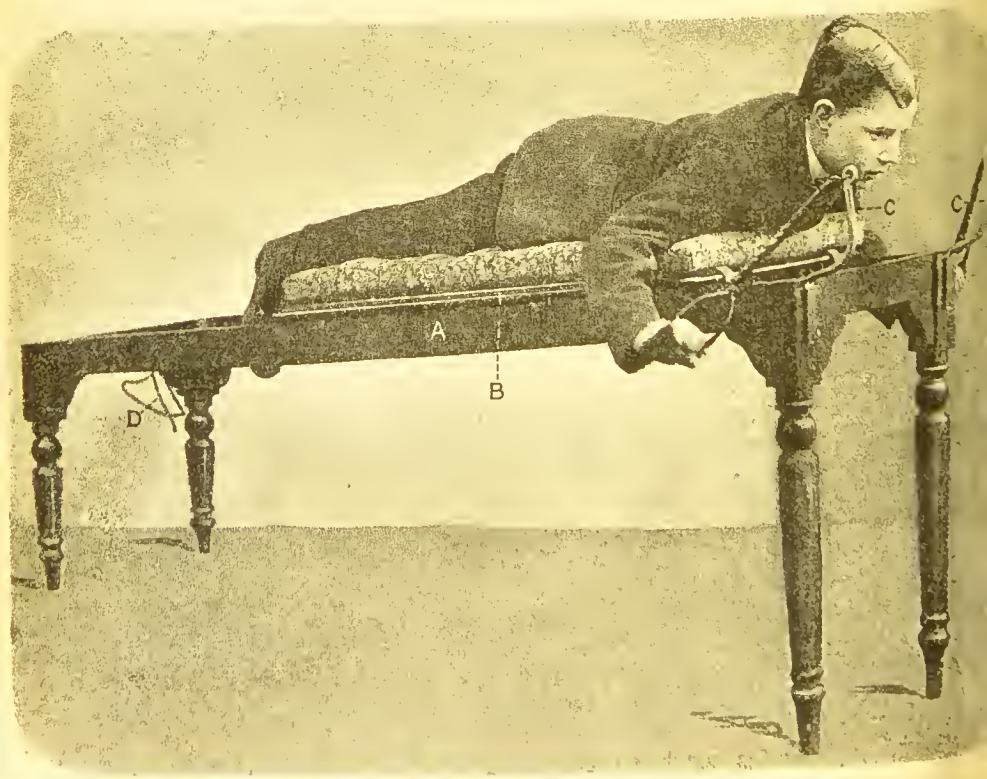


FIG. 64.

the constant jerk caused by the handles being fitted at the side of the couch a few inches apart and projecting like pegs.

Construction of the Plane.

The details of the exercising plane are as follows: an inclined plane A 6 feet long, Fig. 63, Pl. 6, with a rise of 1 inch in the foot. A sliding board B half the length of the plane fitted with rollers, is movable up the plane, working in grooves at the sides, detachable handles C C are fitted to the upper end of the plane, which are grasped by the patient during exercise. An india-rubber accumulator fitted to the top of the couch on the inside, and fastened to the movable board by a cord passing over a pulley at the lower end of the plane is the means by which the exercising power is regulated. This accumulator is not shewn in the illustration, as it is hidden by the plane itself, but the attachment of the cord to the accumulator is shewn at D. The legs are made to screw in and out, in order that the plane may occupy little space in packing.

Position of the Patient in exercising.

The patient assumes two positions in exercising, one on the chest for the exercise and development of the spinal muscles, and the other on the back for the exercise and development of the chest muscles. The respective exercises are taken in the following manner.

Mode of exercising.

The patient lies on the movable board, face downwards, and grasps the handles at the top of the couch, gradually drawing himself up the plane. The hands should be held outwards, imitating as much as possible the breast-stroke in swimming, Fig. 64, Pl. 6. After remaining in this position for a few seconds, the hold should be released and the plane gradually descended. It is advisable to commence the exercises without the india-rubber accumulator, as the weight

of the patient alone up the plane is sufficient exercise at first, but after the speed and position of the hands has been thoroughly mastered, the accumulator may be slightly attached and gradually increased according to the strength of the patient and the facility with which the exercise is performed. In taking the exercise, for chest development, the head rest E is previously placed in the movable board, Fig. 65, Pl. 7. The movement is similar to the preceding exercise with the exception that the arms are brought over the head and close to the side of the body at the finish, Fig. 66, Pl. 7. In severe cases of lateral curvature it is often advisable to alter the length of the handles, giving a shorter length to the opposite side of the extreme curvature. It will be seen that this gives greater exercise and traction to this side.

Single Trapèze Bar.

With reference to the vertical exercises the following apparatus will be found sufficient. Fig. 67 represents the single trapèze bar, which is constructed in the usual way. One point worthy of attention being the capability of adjustment according to the height of the person using it ; this is permitted by use of a bridge piece attached to one end of the webbings, and shewn in detail in the woodcut. In using the bar, it should be fixed at a sufficient height to allow the patient to grasp it on tip-toe. The exercise is performed by swinging to and fro. The single bar is admirably adapted for slight cases of lateral curvature, but in the severer forms it has

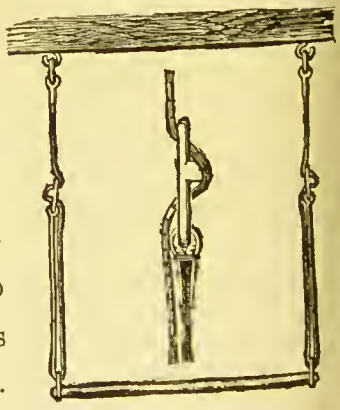


Fig. 67.

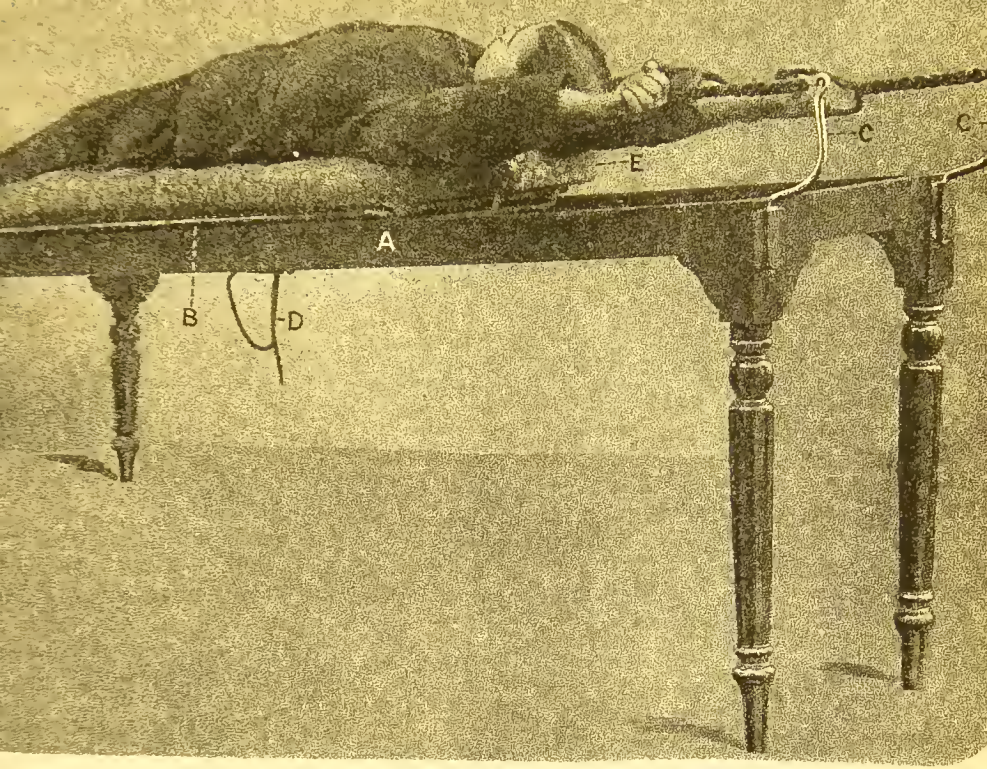


FIG. 65.

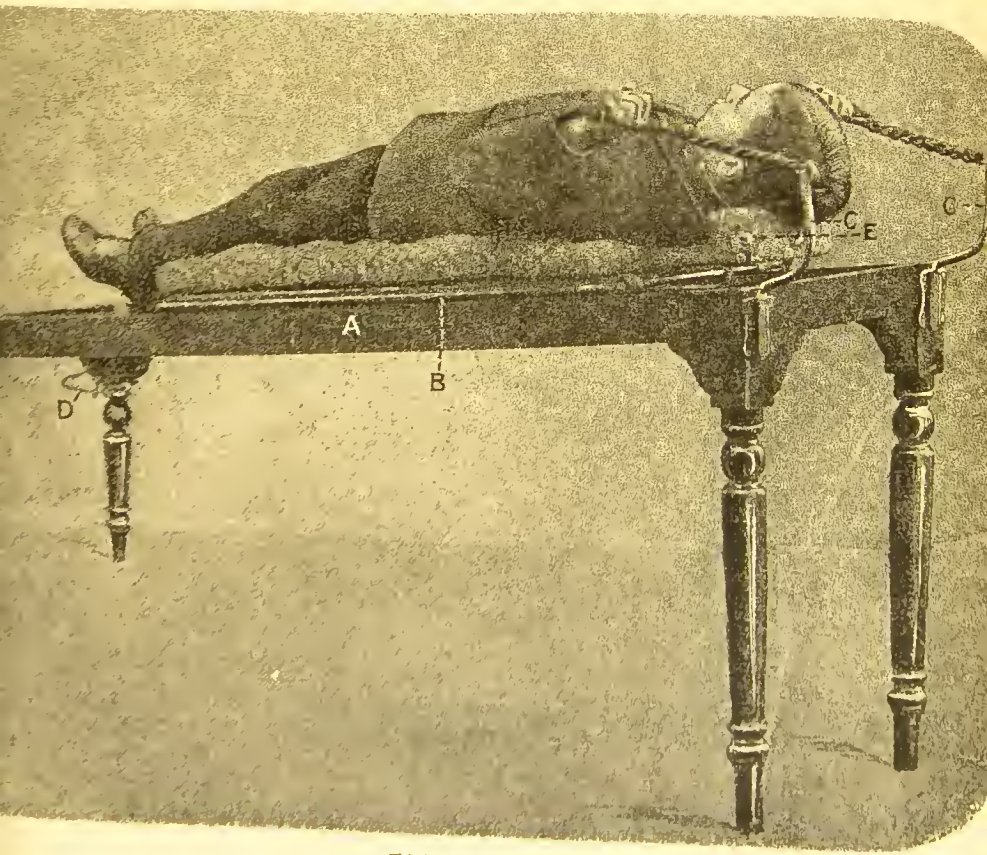


FIG. 66.

FIG. 68.

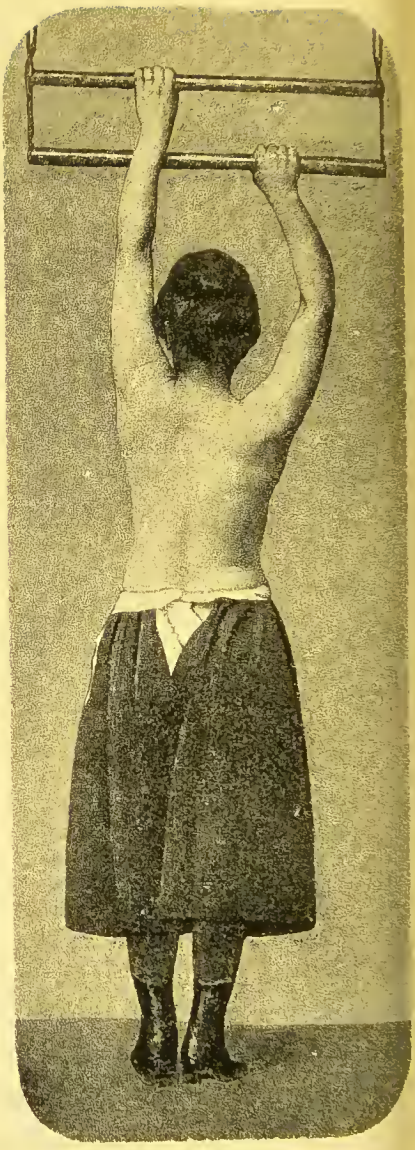


FIG. 69.

been found advisable to add a lower or second bar to the single bar. This idea originated with Mr. Adams, who has very largely used it in his practice.

Double Trapèze Bar.

The double bar is used in the following manner:— the higher bar is grasped by the hand corresponding to the side on which the greatest concavity is situate, the result being that a much greater extension is given to that side, and a consequent increased action to the weakened muscles. Fig. 68 Pl. 8 represents a case of severe lateral curvature, and Fig. 69 Pl. 8 the same case using the double bar. The vertical exercises, taken in the preceding manner, affect the spinal column, from the axillary level downwards; but there are a great number of cases with lateral deviations, in the upper dorsal and cervical region, which can only be benefitted by the Sayres' suspension apparatus.

Sayres' Suspension Apparatus.

Fig. 70, Pl. 9 depicts a case of double lateral curvature with the right curve commencing in the upper dorsal and cervical region. This case is shewn suspended, Fig. 71, Pl. 9, which illustrates the well-known tripod arrangement, the strap and pulleys of which are entirely new, of my own invention, and which in practice I have found to answer admirably. The head strap, of which I give an enlarged view Fig. 72, Pl. 9, takes its purchase from the chin A and the occiput B leaves the ears quite free and prevents that *feeling* of circular constriction so often experienced in the usual pattern. The arm straps are fastened to two small auxiliary bars which are respectively attached to either end of the main cross-bar. The right arm strap is hung straight in front of the patient under the axilla and crossed at the back to the left bar,

and the other strap *vice versâ*. My reason for this is, that in self-suspension with the arm straps there shall be no tendency to "run up" the arm, as there is when the usual vertically hung straps are used. Another great improvement has been added in the shape of the small checks c c attached to the arm and head strap; these entirely overcome the trouble occasioned by the use of buckles and straps, and moreover enables the operator to adjust the distribution of weight on the head and arms with the greatest facility and accuracy.

This very simple arrangement is shewn, Fig. 73, 3 is the ring attached to the end of the auxiliary cross bar; the ball 5 is attached to the arm or head strap, and connected to the ring by the cord 1 4. The section 2 will readily explain the action. In adjusting the length of the strap, it is only necessary to raise the ball 5, and draw the cord 4 either through or out, according to the requisite tension. Another improvement is in the use of a check pulley which fastens itself at any height, enabling the surgeon to dispense with an assistant to hold the cord, and also in the event of sickness or faintness to immediately release the patient from suspension. These pulleys are not given to patients, as an ordinary triple

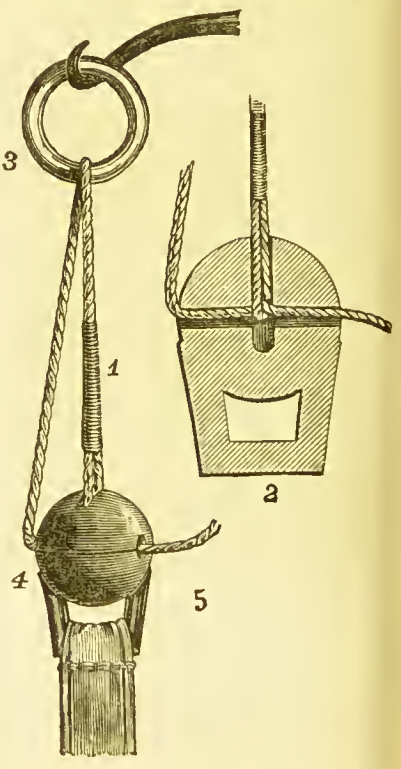


Fig. 73.

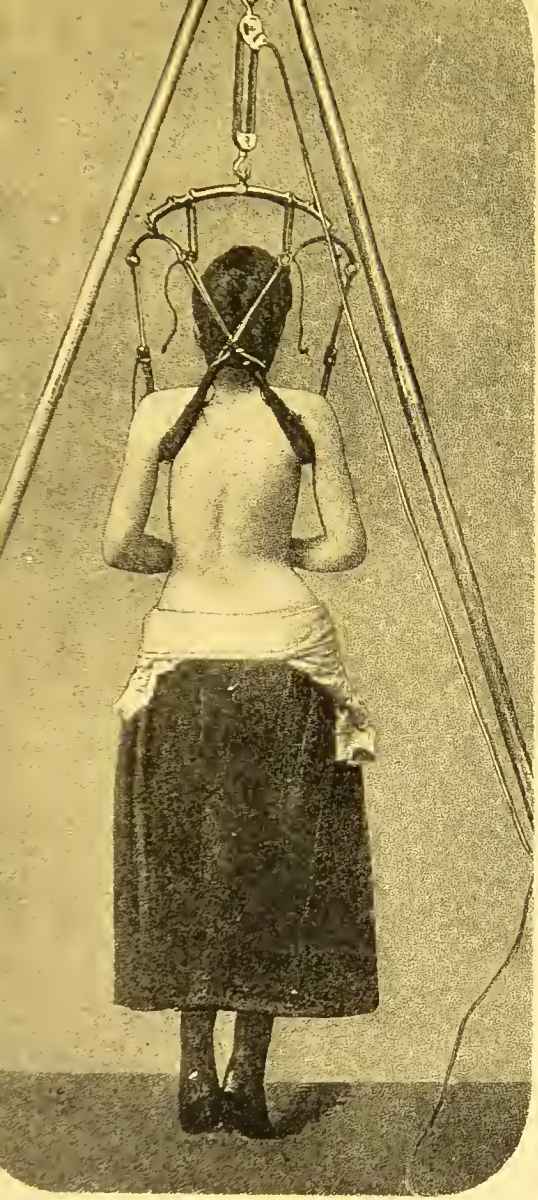


FIG. 71.

FIG. 70.

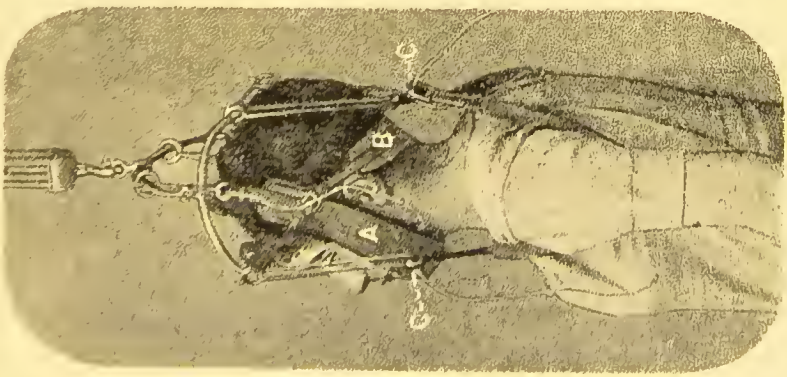


FIG. 72.

pulley is sufficient for the exercises, and, suspended from a hook in the ceiling, dispenses with the use of the tripod.

C. Posterior Curvature of the Spine.

The cause of Posterior Curvature of the Spine being principally connected with muscular weakness, the treatment generally applied is that of gymnastic exercises. Those already described on the trapèze bar, the exercising plane (especially on the back), and the suspension apparatus, shew the kinds most suitable for these cases, and where necessary these may be combined with either of the following apparatus, especially as in many instances the effects of the exercises are greatly neutralized, if not entirely lost, by the bad position assumed during the day.

Elastic Shoulder Braces.

The simplest form of support is that derived from the shoulder braces, Fig. 62, Pl. 5. These are formed of metal scapulæ plates A A attached to a webbing waist band B shoulder straps C C are fastened to the plates and these expand the chest and draw the shoulders back according to the tightness with which they are adapted. As a rule these are only suitable in very early cases, as the fulcrum of the waist band is not sufficient.

Convex Spring Apparatus.

The convex spring apparatus Fig. 73, Pl. 10 represents an efficient means by which the spine may be easily straightened. It is constructed of a metal pelvic band and hip-pieces A A A to which is attached a convex spring back lever B of an elastic and light construction. The convexity of the lever is towards the spine, and to the top of the lever cross arm pieces C C are attached. In adapting the instrument, the pelvic band

is first fastened, and the arm pieces then applied; it will readily be seen that from the nature of the spring, the patient is forced to assume the erect position. In flexible spines this form is very beneficial. Stays, such as Adams', are also useful, and also applied to slight cases. There are a number of cases of posterior curvature of a more rigid type, where a passive support is only required. This can be obtained by the poro-plastic jacket with shoulder straps, the laced shield apparatus,

Mr. Adams' Spring-plate Apparatus for Posterior Curvature.

and Mr. Adams spring plate instrument represented Fig. 74, Pl. 10. As a rule, this is the most efficient instrument for posterior curvature, as the spring plates give a continuous support to the spine, and the pressure once regulated at the fitting, is always maintained, but it is only applicable to conditions of curvature below the axillary level.

Backboard for Children.

In cases of infants with a rachitic tendency, posterior curvature is of common occurrence. Fig. 75, Pl. 10 illustrates a light backboard, very suitable for this class of cases. It is made of a well-padded back-piece A to which is attached axillary and perineal straps B B C C; the appliance is also fitted with abdominal portions D and when the "board" is applied a comfortable support is given, and complete fixation of the spine obtained. The preceding form the principal appliances for this deformity, but modifications and combinations are always being made. In poro-plastic, I have recently fitted a patient with a poro-plastic sheet embracing the entire back, to the upper part of which I attached shoulder straps, and to the lower part a small abdominal portion. This gave a very efficient support, and entire freedom for respiration and development of the chest.

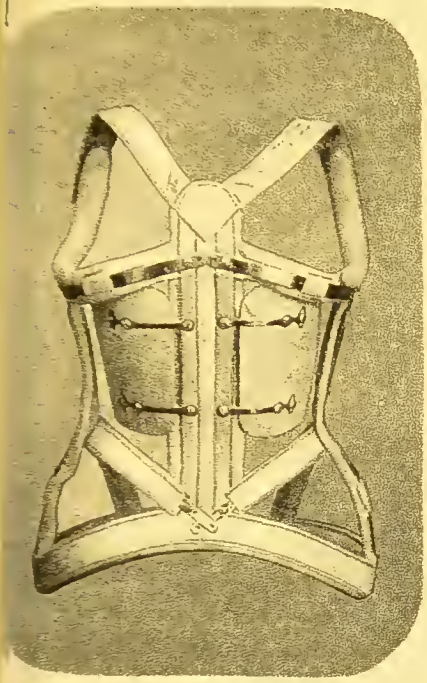


FIG. 74.

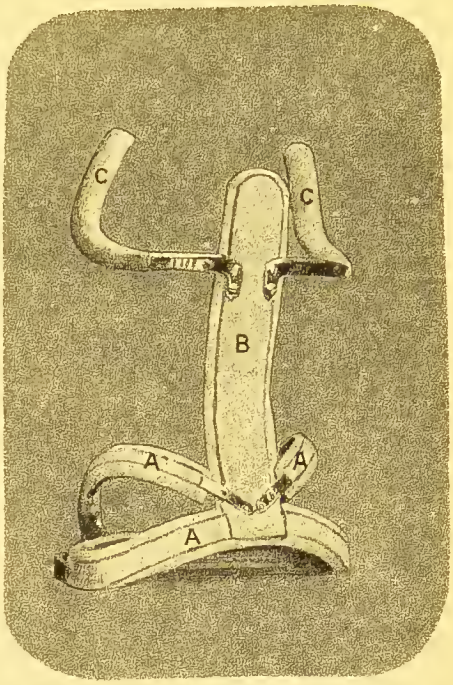


FIG. 73.

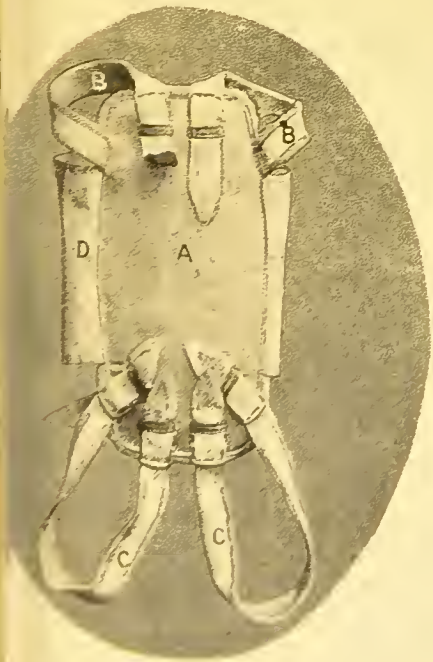


FIG. 75.

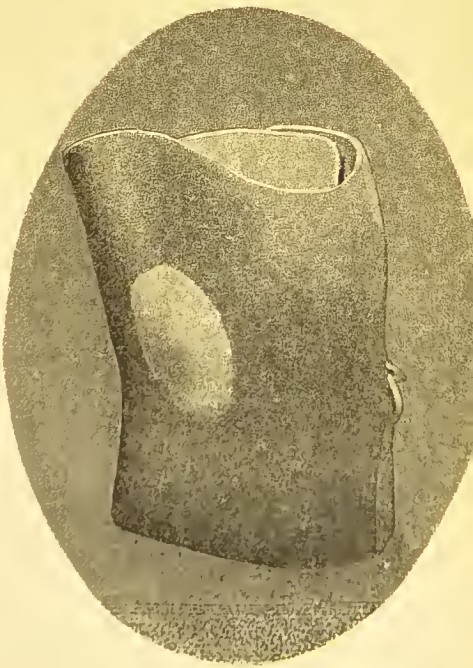


FIG. 76.

D. Pott's Disease of the Spine. Angular Curvature.

In the treatment of cases of Pott's disease considerable difference of opinion exists, as to the most efficient way by which complete rest can be given to the affected part. In some cases entire rest with immobility is advised, and in others rest to the affected part with mobility. The exact course to pursue (and this is always determined by the Surgeon) depends entirely on the constitution of the patient, and the position of the diseased part, and divides the forms of appliance which may be used in the treatment into four distinct kinds, viz. :—

1. Apparatus for commencing caries below the upper dorsal region.
2. Couches for recumbency.
3. Apparatus for supporting the spine in the upper dorsal and cervical region.
4. Apparatus for supporting the spine in the mid-dorsal and lumbar region after consolidation.

In the first class of cases Plaster of Paris has been largely used, and is no doubt of great benefit in the acute early stages, but I believe that the poro-plastic, with very few exceptions, will be found equally good, if not much better, for the reasons already stated.

Poro-plastic Jacket for Angular Curvature.

Fig. 76, Pl. 10 represents a poro-plastic jacket suitable for these cases, with a soft part at the back, and it is this soft part which is of so much utility, and which effectually prevents the sloughing sometimes seen in children upon the removal of a Plaster of Paris jacket. Should the curvature be rather high in the spine, say the 5th or

6th Dorsal, it is sometimes advisable to add shoulder straps to give increased support to the upper part of the trunk.

Mr. Adams' Blocked Leather Cuirass.

One of the most convenient forms of support is the Adams' blocked leather cuirass, Fig. 89, Pl. 15. This is a blocked leather shell or cuirass adapted to, and covering the entire back from the sacrum to the upper dorsal vertebræ. This leather is blocked to a plaster cast of the child's back, taken when in a horizontal position, and with slight extension, which not only insures an accurately fitting support, but keeps the spine in as straight a position as possible. The cuirass is well-padded, and the part over the prominent spine is slightly raised to avoid undue pressure. On either side of the cuirass light steel crutches are attached with softly padded arm pieces, these give an increased aid in standing, and yield the necessary point of counter-support. The thorax and abdomen are covered in by laced portions, wholly made of elastic, giving a firm support, at the same time permitting free respiration and abdominal enlargement. When this apparatus is applied, it enables the child to be readily lifted without fear of injury or movement to the spinal column;—generally the preceding apparatus are advised where partial recumbency only is necessary, and are used in connection with the spinal tray.

The Spinal Tray.

Fig. 83, Pl. 14, represents this, of light wicker construction supplied with a mattress, on which the child is laid and easily carried about without fear of movement to the spine. At the same time, in a large number of cases, complete recumbency is essential. This can be taken on an inclined plane, in bed, on the prone couch, etc. The form of couch depends on the position of the seat of disease. In cases affected in the lower

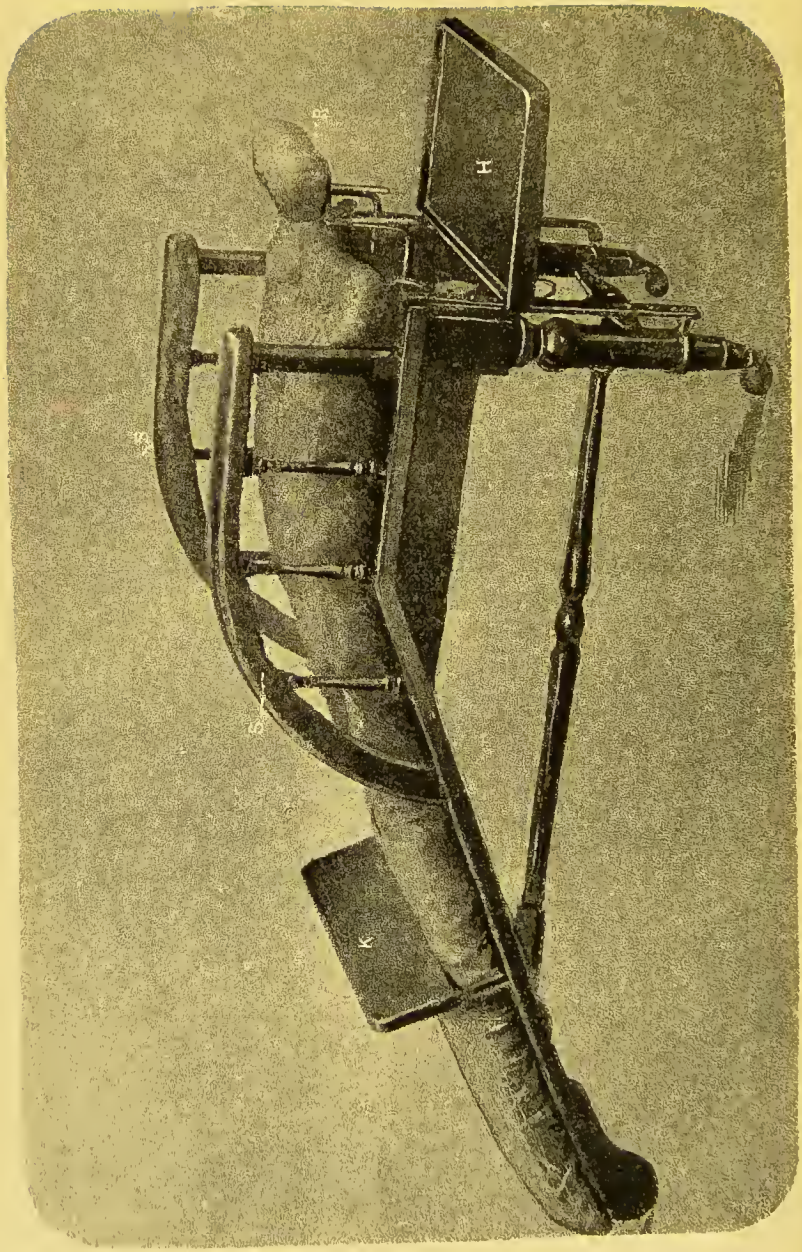


FIG. 77.

dorsal region, so much help is afforded either by the jacket or cuirass, that more liberty may be given to the patient. The prone couch is here very beneficial.

Prone Couch.

Fig. 77, Pl. 11, represents one in which I have made several improvements. On either side of the couch, I have placed guard-rails S S which effectually prevent any accident, especially to young children. The head rest R is made adjustable, and can be heightened or lowered at will. The play-table H is also adjustable, and in addition to its advantage from the point of amusement, it serves as well for educational purposes. The plane of the couch is broken at a point corresponding to the hip joints, and as the lower extremities rest on the inclined part, a certain amount of extension of the spinal column is gained. The footboard K which is detachable, serves as an occasional rest for the lower extremities. Where the disease appears in the acute form in any portion of the spine, complete rest is essential, but is not so easily attained with young children. It is well known how difficult a matter it is to keep a child in one position, yet how essential especially in cervical caries. To ensure this complete recumbency Mr. F. R. Fisher has devised the annexed bed frame.

Mr. F. R. Fisher's Bed Frame.

Fig. 78 illustrates the bed-frame, by the use of which, absolute rest to the spine is obtained. It consists of three pieces of metal, a top piece A A and two side stems C C the latter are joined to the former at one end, and fixed by thumbscrews; halfway between the ends of the side stems light metal arm pieces are fixed (softly padded), these are passed under the axillæ, and buckled over the shoulders. The top bar

of the frame is attached to the head of the bed by the straps B B and to the lower ends of each stem a bandage is tied and securely fastened under the bedstead. When the child is placed in this

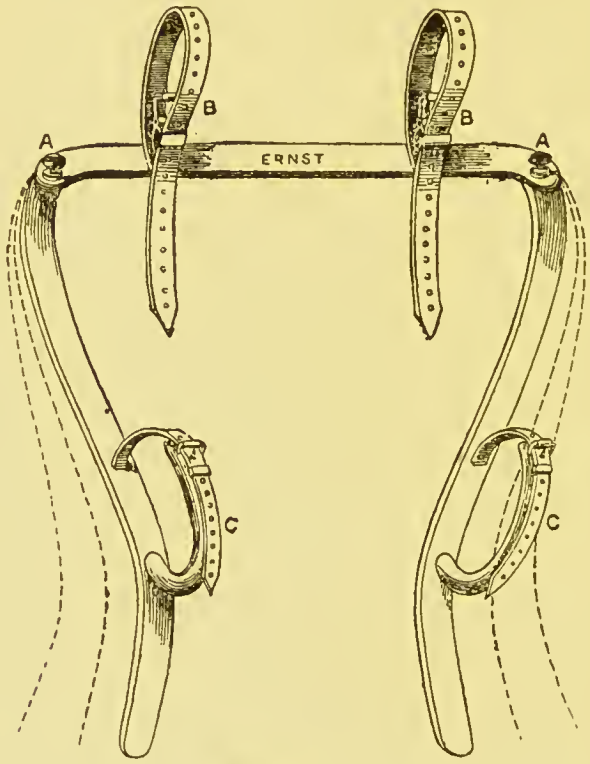


Fig. 78.

frame, no movement or rotation can take place, all movements of the trunk are prevented, and the restraint thus obtained is not in any way irksome. Not only in cases of spinal disease, but as a means of counter extension in hip joint disease, this frame will be found very valuable. Referring to the point of general health, I have lately made a poro-plastic trough, padded to the shape of the body, in which the patient can be placed and taken from place to place, or into the air without any

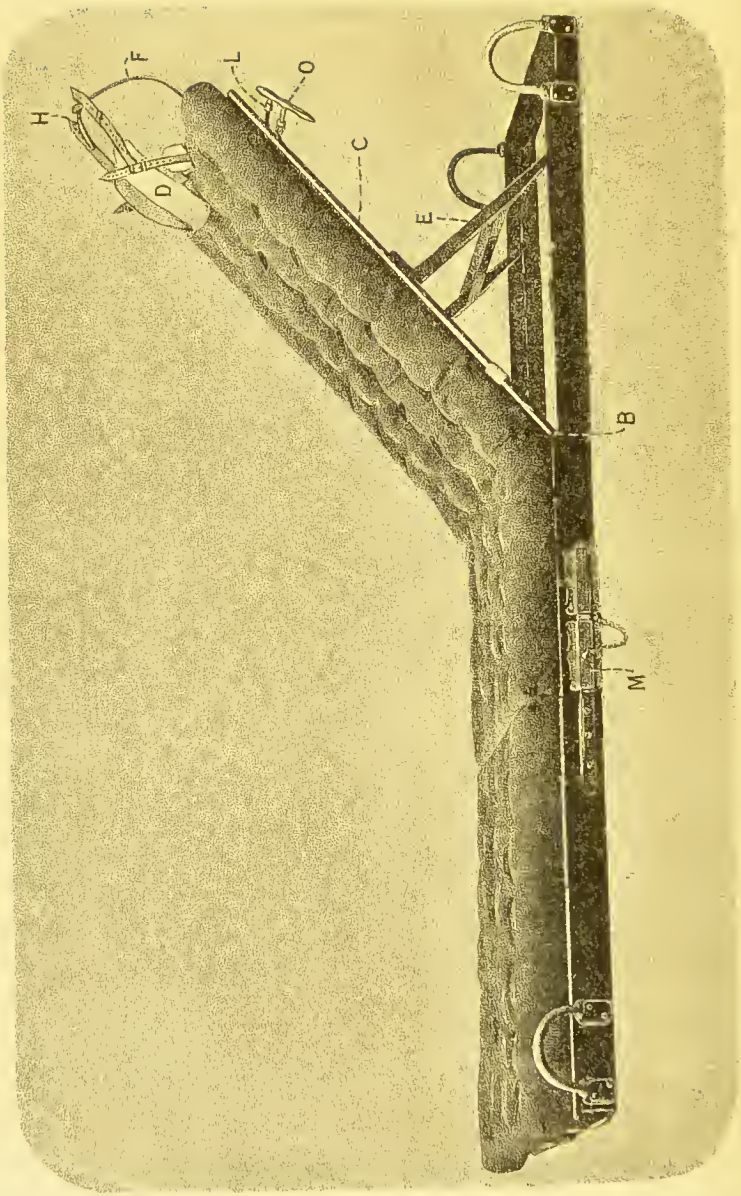


FIG. 78.

movement to the spine. In many cases of cervical disease, entire or partial paralysis of the lower extremities takes place. In this acute form it is essential to apply extension to the head. This has been done by fixing a pulley over the bedstead, and making extension by the adaptation of a head-strap, but as this involves continuous recumbency in one place, I have devised an extension couch, which I believe contains entirely new principles, and which in practice has been very successful. In designing it I have kept in mind two points, first an unaltered extension force in any position, second the capability of moving the patient from place to place, with a view to the maintenance of the general health.

Ernst's Apparatus for Extension for Cervical Caries.

It is carried out in the following manner:—Fig. 78, Pl. 12, represents a tray jointed at its upper third B this joint corresponds to the hip joint, and the shorter part of the tray C is adjustable to any angle of inclination by an ordinary rack adjustment E a horse-hair mattress covering the tray. The patient is placed on this tray, and a well padded leather belt encircles the pelvis. It is only in the horizontal position that this belt is necessary, as when the patient is reclining at an angle, the weight of the body is a sufficient counter extension. The head is then placed in an ordinary head strap D (my improved pattern) and this in turn attached to a cross (metal) piece A at the top of the couch and terminating in a stem F similar to that of a jury mast. This stem is fixed at the back of the adjustable board, and moved by a ratchet movement, which constitutes the extending medium. When the straps have been carefully adapted, extension is made by a

key O and kept in position by a set screw L. It will therefore be seen that extension may be carried on horizontally, vertically, or at any angle most comfortable to the patient. The great advantage of this change of position is obvious, for the retention of one position is very tedious. Another important feature in this mode of extension is the accuracy with which the tension can be regulated, the ratchet movement being adjustable to one-eighth of an inch. Again, the extension movement being fixed to the board, the patient is easily moved without altering the position, and the same amount of extension is always maintained. To further improve this tray and facilitate the carrying of the patient up and down stairs, I have just constructed one with the lower part detachable. This is shewn in the illustration Fig. 78*a* Pl. 12*a* and adds greatly to the comfort of the patient, and the retention in the horizontal position while being moved. It will be noticed that the lower third of the tray is detachable, and carrying handles S S are inserted into the sockets M. The couch being thus converted into a carrying chair.

The apparatus I place under the heading of third class, are those suitable for affections of the spine in the cervical and upper dorsal region when the acute stage is passed, in all of which cases it is requisite to support the head and remove its weight from the spinal column.

Cervical Collar.

The simplest form of these apparatus is the cervical collar, Fig. 78*b*, the

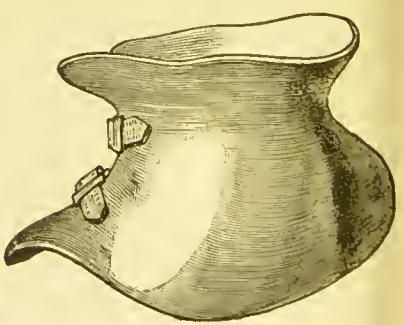


Fig. 78*b*.

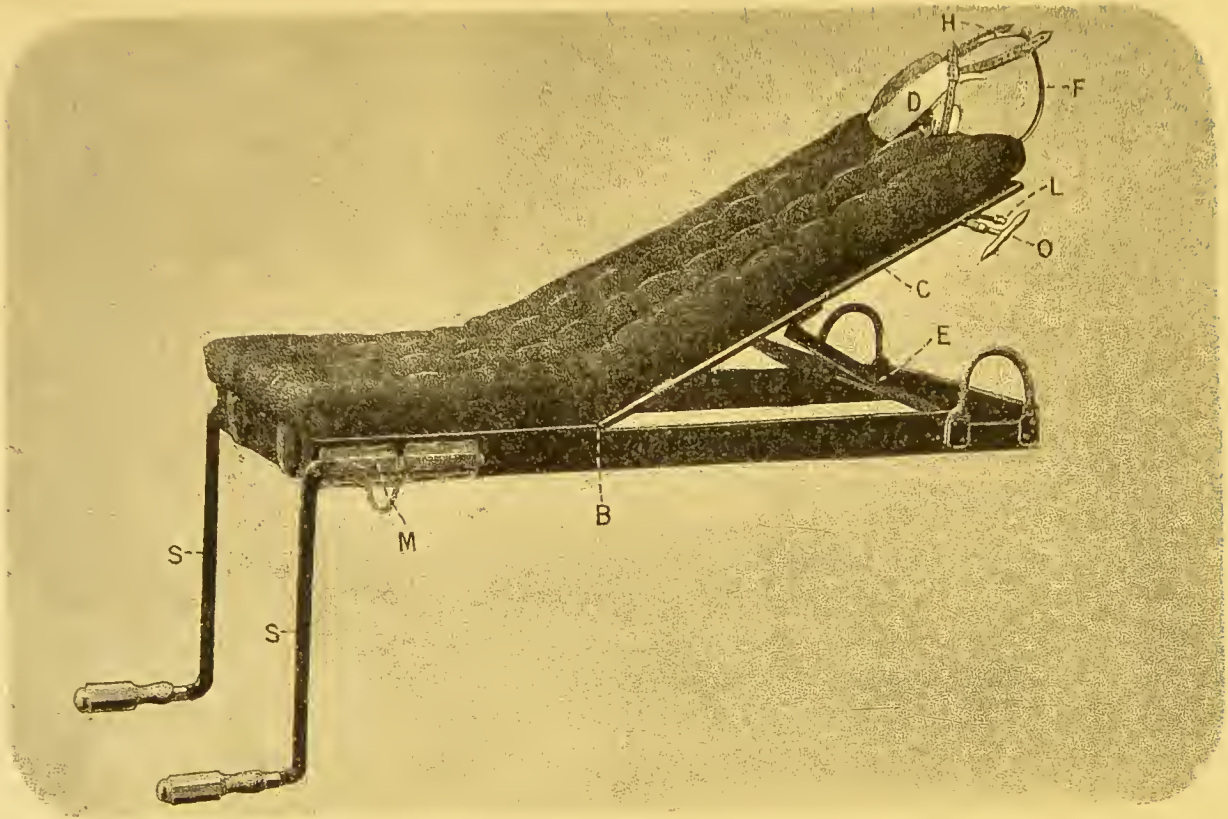


FIG. 78A

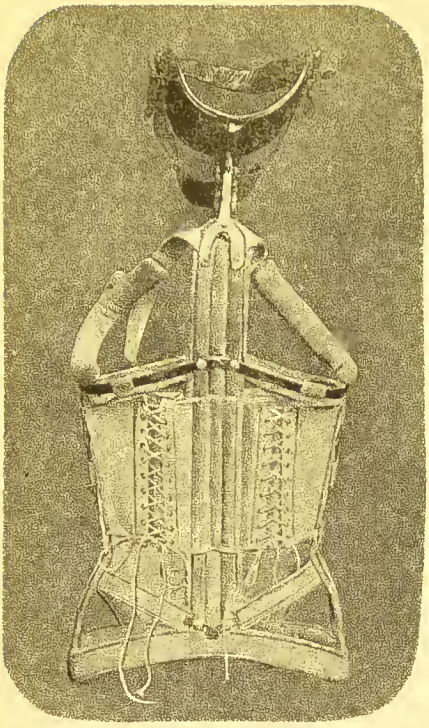


FIG. 80.

FIG. 79.

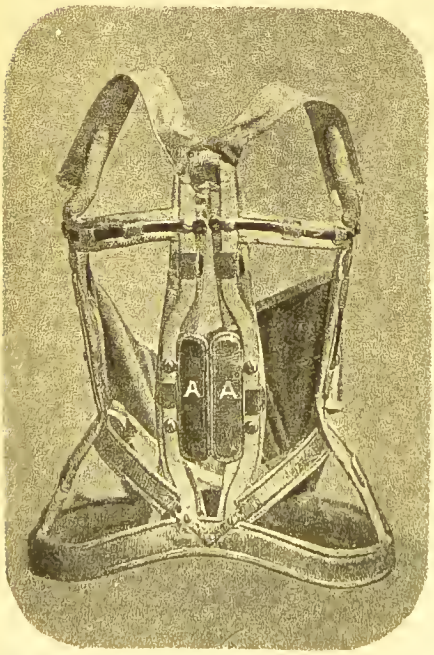


FIG. 81.

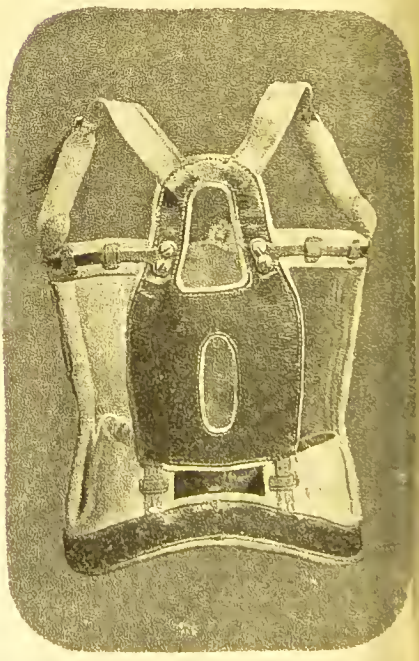


FIG. 82

object of which is to remove the weight of the head from the cervical vertebræ and transmit it to the shoulders.

Sayre's Jury Mast.

The next grade of support is the Sayre's jury mast, which is here represented, Fig. 79, Pl. 13, as attached to a poro-plastic jacket. This is already so well known that I need not refer in detail to its construction. Two points are, however, worthy of attention—firstly, the head strap, which is made according to my pattern; and secondly, the divided attachment of the stem A A to the jacket. This brings the bearing of the stem on either side instead of over the projection, as in the single method. It is made to elongate in accordance with growth. Another form of support is the jacket with occipital head-piece, Fig. 84, Pl. 14, where the same principle of attachment to poro-plastic is carried out, but where the mechanism and principle of support is my invention. The divided neck stem A terminates in a broad occipital portion B covering a large area of support, which is fitted closely to the head, and consequently the apparatus is much less unsightly than the jury mast. This apparatus has a noticeable piece of mechanism in the extension movement, which enables the easy adjustment of the occipital piece. It is composed of the neck stem A terminating at C in a ratchet arrangement, with the teeth cut on either side and inversely to each other. Small levers fit into these teeth, and these are kept in position by side springs. To heighten or depress the occipital piece one of the levers is drawn back and the neck stem moved accordingly. The opposite lever immediately snaps into the next tooth or more, as the case may require, and thus the very accurate adjustment of the support is

Ernst's Occipital Head-Piece.

obtained, below this ratchet arrangement the neck stem is slotted at H; by this means and the thumb-screw L the neck stem can be removed from the jacket altogether. This in the latter stages of treatment is an advantage.

The disease of the axo-atloid process is of so rare an occurrence that I would draw special attention to the following apparatus which I recently fitted very successfully to such a case. The peculiar feature of this apparatus consisted in the method by which the head was supported, and as the appliance contains several important points, I will describe its construction in detail.

Apparatus for Disease of Axo-Atloid Process.

Fig. 80, Pl. 13, illustrates the apparatus, and, as in the Adams' wry neck instrument, my fulcrum was taken from the pelvis and hips; the pelvic band being shaped in the crescent form, a strong double back lever was attached to the centre of the pelvic band, extending to about 14 inches up the spinal column; at the sides of the apparatus two crutches were respectively attached, terminating in arm pieces. These arm pieces being so fitted not merely as a support to the shoulders, but acting principally as a point of counter-pressure, taken from the front upright portion of the arm pieces. The scapulæ cross bars being attached to the arm pieces and back lever a firm fulcrum and point of counter-pressure were established, thereby giving an efficient support to the spine from the mid-dorsal to the lumbar region, and also providing a good foundation for the head-piece. In addition to this, light laced-shields were attached from the back lever to the side crutches to give an increased general support to the spinal column. The head piece was composed of two

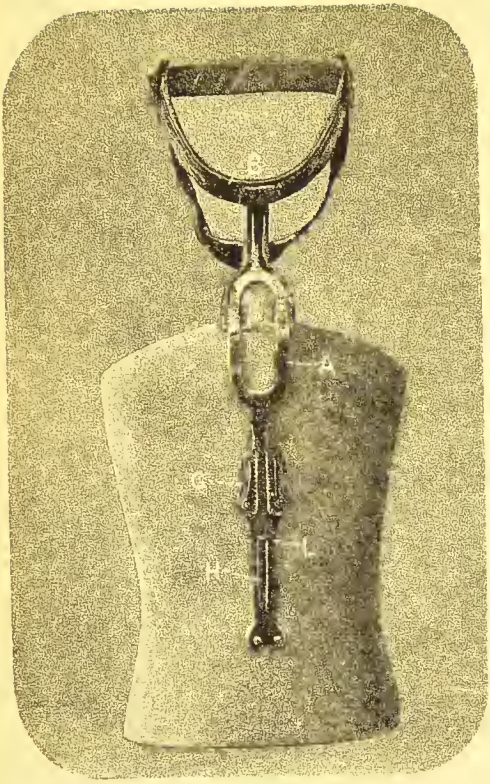


FIG. 84.

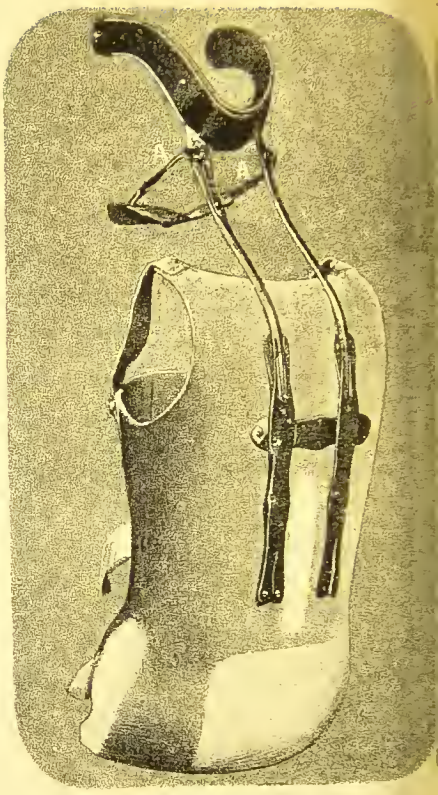


FIG. 85.

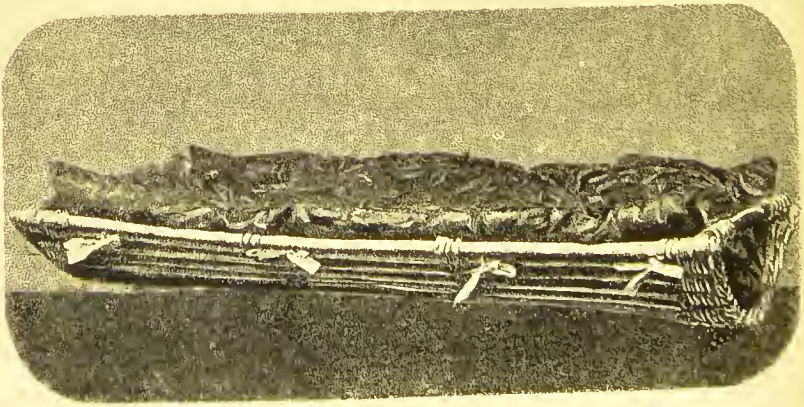


FIG. 83.

parts, the occipital and forehead plate, and the lower maxillary plate; the former received the head at the base of the occiput passed over the ears terminating at the side of the forehead; the lower maxillary plates (the most important feature of the instrument) were made detachable from the occiput plate at the back by a spring catch, and closely fitted the lower maxillary and side of neck. These plates were made of spring tempered steel, and secured in front by a small strap, which although preventing any lateral movement allowed sufficient play for mastication and articulation. By this arrangement the old chin strap was dispensed with, and a greater fixation of the head obtained. This point of the maxillary stem is not illustrated in this figure, but will be seen to advantage in Fig. 85, Pl. 14, the reason being, the apparatus having been returned for some slight alteration, the chin pieces were not sent and I was consequently obliged either to photograph the apparatus as it was, or lose the chance of getting a representation of it. In a case of rigidity of the vertebræ where cauterisation was applied, I have lately adapted a jacket and head piece with maxillary plates, the principal feature of which is centred in the divided neck stem; this was designed to permit dressing of the wound without removal of the apparatus. The detachable chin pieces spoken of in the preceding figure being well illustrated at AA. With reference to the treatment of

Apparatus with Neck Stem.

cases of cervical caries I would refer to Mr. F. R. Fisher's work "The Treatment of Pott's Disease of the Spine" (Churchill 1879, p. 4), in which he says "The most efficient instrument to use in a case of disease of the cervical vertebræ is one of the pattern here figured, Fig. 86.

It consists of a pelvic band, hip pieces and crutches" . . . . "The back lever is carried to the occiput and provided with chin and forehead straps, attached to an occipital plate, the lever being also made to elongate, so as to regulate the amount of extension required. With this instrument (Ernst's pattern) the vertebræ are kept steady and are relieved of the weight of the head much more effectually than by use of the Sayre's jury mast apparatus, which only gives extension and does not limit movement."

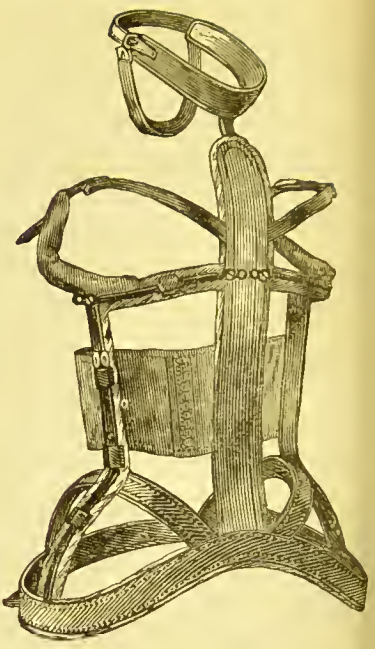


Fig. 86.

The fourth class of cases embraces those instruments which are used after consolidation of the vertebræ has taken place and where passive movements are permitted. A great difference exists in the details of each case, and several appliances are all suitable in their way. A great deal depends on the physical condition of the patient and whether the necessary points for support can be obtained. The felt jacket is particularly suitable for young children and boys up to the ages of 12 and 14, as there is no development of the hips such as in girls of the same age, it is therefore practically impossible to obtain the necessary fulcrum for the adaptation of a mechanical support, whereas the jacket being a circumferential support fits every part of the body and gives the requisite aid. In many cases it is not unusual to find a tendency to lateral

bending when the patient commences to sit up and move about, and if this tendency be not counteracted, lateral curvature will be developed. It is therefore necessary to have a partially active support and this is best obtained in one of mechanical form.

Light Steel Support for Slight Angular Curvature.

Where very slight angular curvature exists, the apparatus, Fig. 87, will be found very serviceable, formed with the usual pelvic band hip pieces, side crutches and back lever. The ordinary corsets can be worn over this and it is very suitable for young girls, as there is ample room allowed for development.

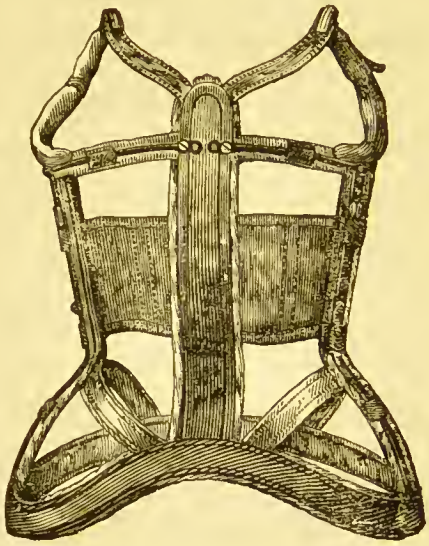


Fig. 87.

Light Spring Plate Support for Angular Curvature.

Fig. 81, Pl. 13, represents a light steel apparatus, adapted to a case of angular curvature in the lower dorsal region. The principal points are obtained in the frame, which is of the ordinary character, having the exception that the back lever is widened at the projection of the spine, where two small spring plates A A are attached to maintain a light and easy support to the spinal column. Should the tendency to lateral bending be very severe, it is advisable to attach either a spring plate, laced shield, or combination of both to the side where the deviation is situated.

Shield Support for Angular Curvature.

Another form of apparatus Fig. 82, Pl. 13, is also useful in cases where the pressure of the spring plate cannot be borne. It is precisely similar to the

preceding figure, but in place of the spring plates the entire surface of the projecting spine, with the exception of an aperture for the projecting spinous processes, is covered with a leather shield, this gives a much greater supporting surface, and diminishes the pressure, which in sensitive cases is a most desirable object.

Dr. Dick's Apparatus.

An adjustable retentive apparatus of Dr. Dick's design is illustrated, Fig. 88, it is similar to the previous diagrams of his principle. In this apparatus the back lever *f* is sufficiently wide to permit of the attachment of two pressure plates *d d* which are placed in position and advanced by the rack movements *e e*. It must be clearly understood that this mechanism is used simply with the view of accurately adjusting the support, and not with any idea of reducing the curvature, which is an impossibility.

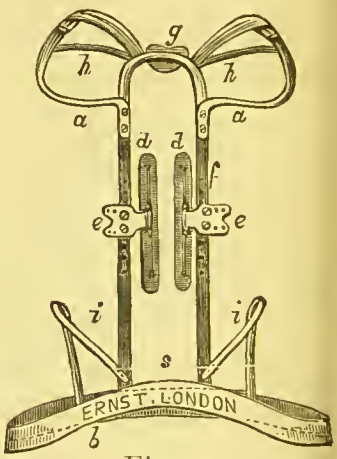


Fig. 88.

After one of the preceding forms of apparatus have been worn and muscular strength is again established, it is usual to dispense with the apparatus, but previously to discarding it entirely, it is advisable to use a light belt as a medium between the great help afforded by the steel apparatus and the absence of any support.

Supporting Stay Belt for Angular Curvature.

Fig. 90, Pl. 15, indicates a serviceable form which is largely in use. It is made of a strong moleskin strengthened with steel (on either side of the spine) and whalebones; in some cases elastic may be inserted to give

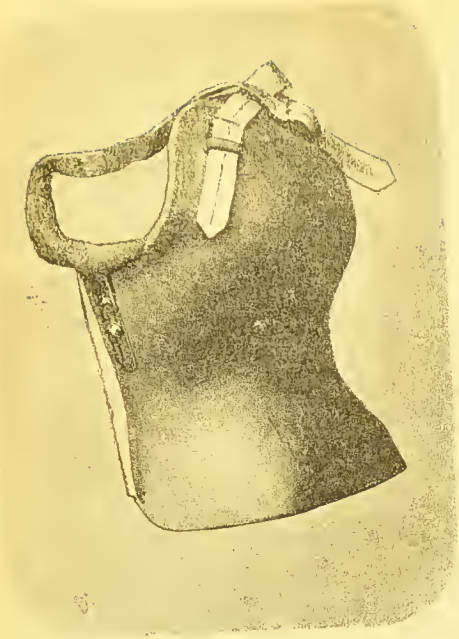


FIG 89.

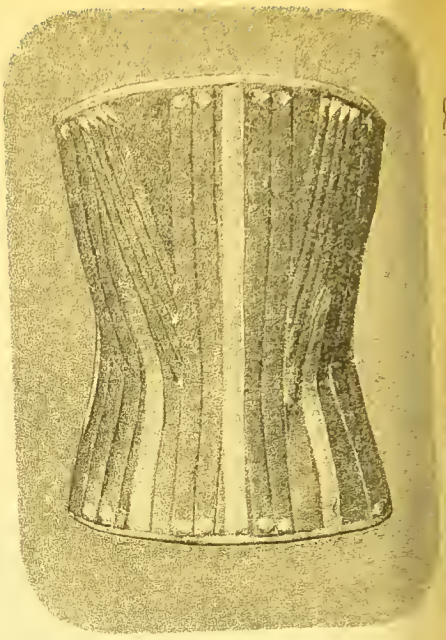


FIG. 90.

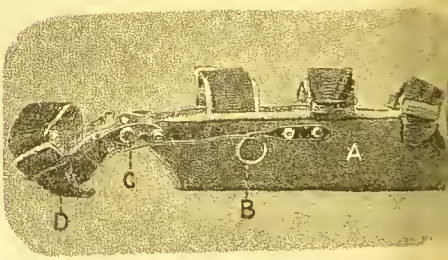


FIG. 93

FIG. 91.

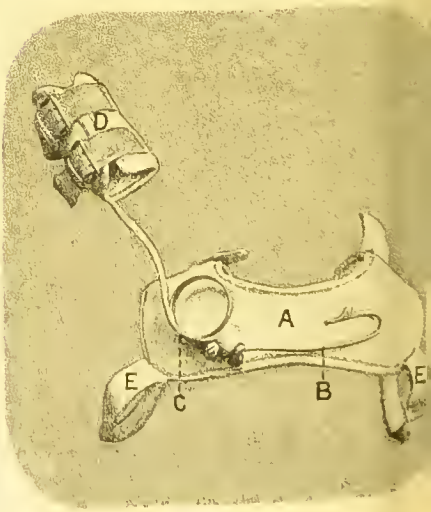


FIG. 92.

greater freedom of movement. This belt may be also very beneficially used in cases of spinal debility.

Prominent Sternum or Pigeon-Breast.

The deformity of prominent sternum or pigeon-breast, although more or less inseparably connected with angular deformity of the spine, is frequently met with in cases without a trace of spinal curvature. Hitherto little has been done in the way of treatment of these cases; but with the results obtained at the National Orthopædic Hospital, there seems to be every chance of greatly improving, if not curing entirely, this deformity. When the pigeon-breast is the result of angular deformity of the spine, nothing can be done; but in the other class of cases, I have successfully fitted the apparatus, Fig. 91, Pl. 15. The base is a poro-plastic back piece A as fulcrum, to which is attached shoulder-straps B B and an abdominal belt-piece C to keep the back piece in position. The active part of the apparatus is comprised of a sternal spring D at the end of which is attached a sternal plate E covering the projection. This plate is made in the shape of an oval with the centre open to avoid any prominent pressure. This form of apparatus is used in cases where one side of the sternum is more prominent than the other. In cases of equal projection I use a sternal ring attached to the poro-plastic fulcrum by lateral straps, which give an equal pressure to the plate. Another improvement is the use of a conical spring affixed to the sternal ring, exerting a direct pressure on the extreme prominence, but this is only adaptable to slight cases where the prominence is not very sharp. By means of the spring a considerable pressure can be borne as it admits of free respiration.

CHAPTER V.

APPARATUS FOR AFFECTIONS OF THE SHOULDERS, ELBOW, AND WRIST JOINTS, AND CONTRACTION OF THE FINGERS (DUPUYTREN'S).

The mechanism for the upper extremities consists entirely in the application of the spring, and rack and pinion movement to the cure and relief of the various deformities. These latter resolve themselves principally into two classes, viz., contracted and paralytic. I will take the latter class first, and although a great deal of help may be given in cases of partial loss of power, where the loss is absolute, little can be done. Recently a case was sent to me from one of the leading hospitals for paralysis, a case of a man with entire paralysis of the flexors and extensors of the arms, but power existing in the fingers. As the patient was a pianist, it was thought that some aid might be given to enable him to follow his calling. At first I anticipated that if an apparatus could be fitted so as to keep the lower arm at right angles to the upper, that the end would be obtained; but on making a temporary adaptation, I found that owing to the entire loss of power above the elbow, the arm simply hung at the side at a useless angle. Unfortunately, I could do nothing, and I simply mention this to give some idea of the difficulty experienced in this class of cases. Where partial paralysis only exists, much may be done.

Apparatus for supporting paralysed arm from the shoulder.

The following appliance, Fig. 92, Pl. 15, is designed to give assistance to the upper arm, where paralysis at the shoulder exists and where power of flexion and extension remains below the elbow. It is exceedingly useful as a means of keeping the hand at a certain level, so that ordinary work, engaging the fingers only, may be undertaken. It consists of a shoulder-piece or fulcrum A fastened securely by axillary straps E E. The arm-band D is attached to this shoulder-piece by an arrangement of the "centrifugal" C and "gun-lock" B springs, this combination giving great elasticity. The illustration shews the arm piece fully uplifted, in application the arm band is adapted under the arm, and exerts the full uplifting force.

Apparatus for Paralysis of Fore-arm.

Partial paralysis at the elbow joint, (viz., with loss of flexion force) but with power at the shoulder, frequently occurs, and in these cases an apparatus constructed after the following principle may be successfully applied. It is made of an upper and lower arm-band, jointed and connected at the elbow by metal stems. The flexion movement consists of spiral springs connected by a metal chain, and working over rollers, fixed above the axis of the joint. I have lately had a case of this kind with the exact condition of paralysis that I have described. I made an apparatus similar to the preceding description, but with a centrifugal spring at the elbow joint. This spring kept the arm at a right angle, and enabled the man (an agricultural labourer) to follow his occupation at general farming work. Paralysis of the wrist joint, with power at the elbow and shoulder, is also of frequent occurrence.

Apparatus for Paralysis at the wrist joint.

The apparatus, Fig. 93, Pl. 15, is very serviceable in these cases. This instrument is also applicable to cases of spastic contraction where an elastic force is required. It is composed of an arm plate as fulcrum A connected to the palmar plate by two side stems, having free joints C on either side, and corresponding to the wrist joint. The uplifting or extending force is contained in an "elevating" spring B attached to the arm-plate, and acting on the palmar plate D on a small roller which gives an easy movement to the spring and tends to minimise friction. This elevating spring is usually adjustable so that the exact power can be regulated. In many cases of a spastic nature it is necessary to extend the palmar plate to the ends of the fingers as contraction often exists here in addition to the wrist. The foregoing apparatus form the principal movements in cases of a paralytic nature, and each can be used separately or combined according to the necessities of the case. In this class of cases I would emphasize the need for the regulating power to the springs as it is a difficult matter to give the accurate temper before making experiment, and by the regulation movement the diminishing or increasing of power is left in the hands of the surgeon. In contractions of the arm resulting from burn cicatrices, badly united fractures, etc., the rack and pinion movement is in general use.

Dr. Little's Apparatus for effecting Supination of Arm.

Fig. 94 Pl. 16 represents Dr. Little's apparatus for effecting supination of fore-arm and outward rotation of arm. This figure explains the back view of this apparatus which has a shoulder piece as fulcrum A fastened in position by a broad strap B passing round the axillæ in a

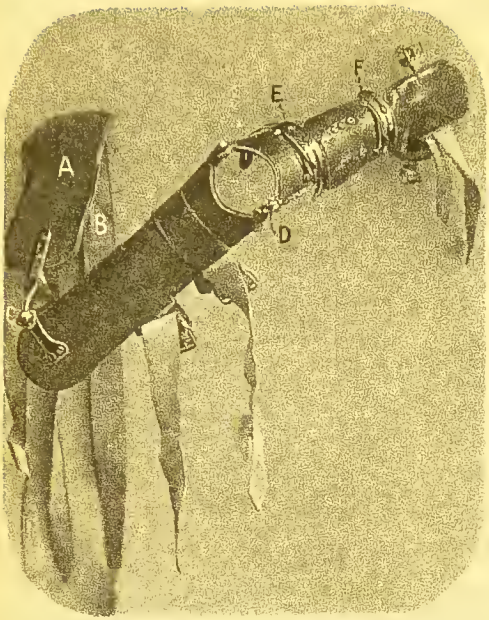


FIG. 94.

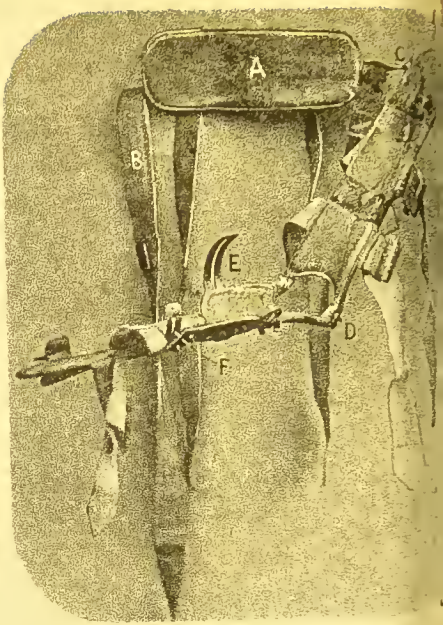


FIG. 95.

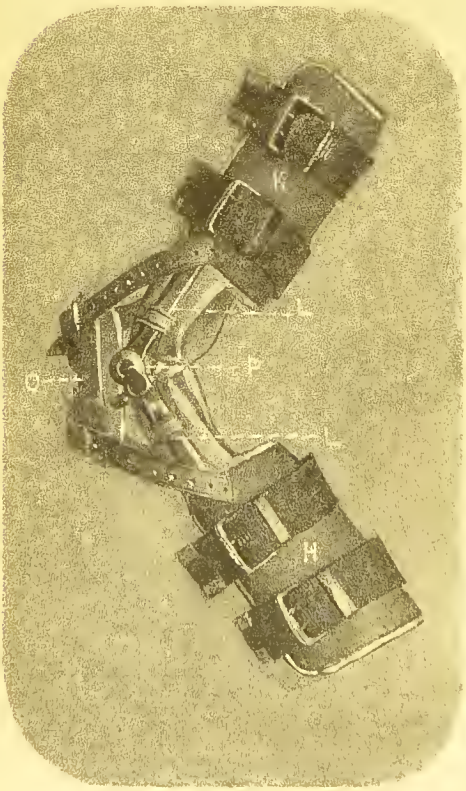


FIG. 96

FIG. 97.

figure of 8. This is connected to the arm mechanism by a ball and socket joint at the shoulder C fixed by a "set" screw to prevent rotation. Extension at the elbow joint is made by a rack and pinion movement D and the supination of the fore-arm is effected by two divisions of the fore-arm plate E F fitted with rotation ratchet movements. A side view of this apparatus shewing the position of the mechanism is given Fig. 95 Pl. 16.

Apparatus for Contracted Elbow.

The contraction of the elbow joint is of frequent occurrence, and may be remedied by two instruments, containing the following powers, extension with immobility, and extension with mobility. In the former case the apparatus, Fig. 96 Pl. 16, is fitted with an upper and lower arm plate H K connected by the side stems L L and fitted with a rack and pinion movement P. This enables the ready adjustment of the apparatus to the contracted state of the arm, after which gentle extension is carried out by the movement. Counter-extension is obtained by the elbow cap O. It is sometimes necessary to use extra pressure straps above and below the joint, as continuous pressure cannot always be borne on the olecranon. These are independent of the instrument, and buckled round the connecting stems L L. In cases where mobility is desirable the rack and pinion movement is substituted by a regulating spring action.

Apparatus for Contracted Elbow and Wrist.

The combined contraction of elbow and wrist joint may be remedied by the apparatus, Fig. 97 Pl. 16, which is somewhat similar in construction to the preceding instrument. In this combination, rotation of the fore-arm is often met with, and the apparatus is therefore made with a

ratchet rotation movement A. The extension of the arm is gained by a rack movement B and counter-extension obtained by a "set" screw and plate D. The extension of the hand is also made by a rack movement E and counter-extension by the plate H. It is always advisable to extend the hand plate to the tips of the fingers, as more force is obtained and a greater rest given to the hand during treatment.

Dupuytren's Contraction of the Fingers.

In the treatment of Dupuytren's contraction of the fingers by division of the fascia, there are several apparatus necessary, and these are indicated according to the degree of the contraction. There are two distinct conditions of contraction, viz., palmar and phalangeal, indicated by the illustrations of typical cases, Figs. 98 and 99, Pl. 17. In the former class it is generally found that the fingers can be extended immediately after the operation, and it is therefore only necessary to use the operation splint. This splint is a flexible piece of metal, about 8 inches long and 1 inch wide, very softly padded. It can be bent to the outline of the hand, is applied on the palmar surface, and retained in position by a bandage. After this splint has been worn for a fortnight it is desirable to have a form of retentive splint which the patient can easily apply himself.

Beattie's Retentive Splint.

The simplest of these is the Beattie's splint, Fig. 100, Pl. 17. It is a piece of metal extending along the finger and the dorsum of the hand, with a loop to catch the end of the finger, and fastened by a wrist band. I have made this splint with a steel spring, which has given a certain degree of mobility and relief from the rigid extension. This splint is only suitable for very slight cases.

FIG. 98.

FIG. 99.

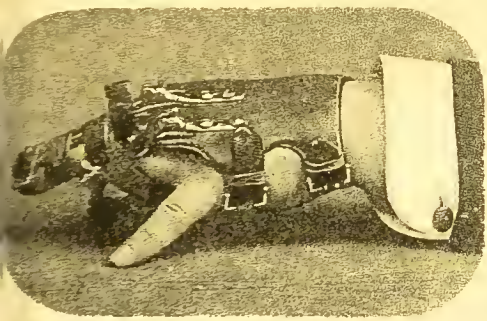


FIG. 102.

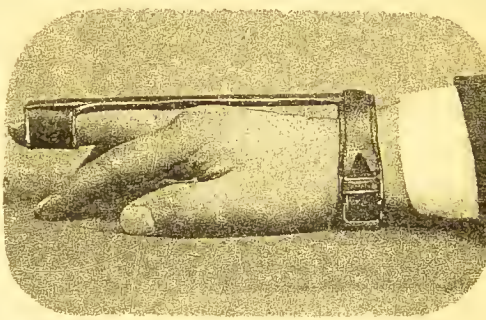


FIG. 100.

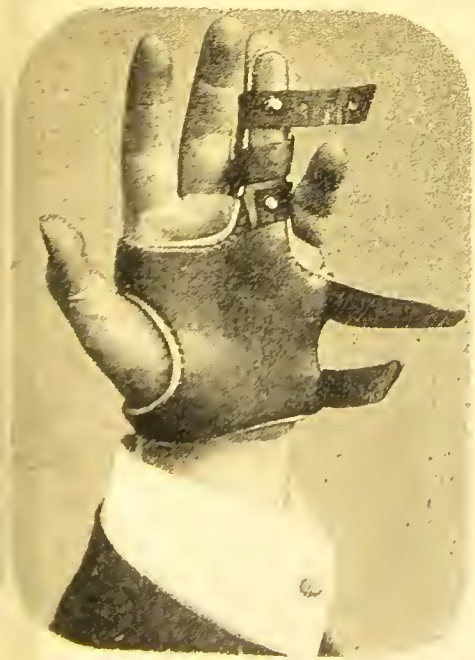


FIG. 103.

FIG. 101.

Pistol Splint.

In the severer forms, the pistol splint, Fig. 101, Pl. 17, is much used. It is applied on the palmar surface, attached to the hand by dorsal straps, and the finger fastened to the splint, by a narrow silk strap, twisted spirally round it. In the cases of phalangeal contractions, it is necessary to have a more elaborate and adjustable apparatus. Immediate extension of the second and third phalanges cannot always be made, as it depends on the length of time the contraction has existed, and in cases of some duration, contraction of the ligaments has to be overcome; it is therefore necessary to have an apparatus with rack and pinion movement. This is illustrated, Fig. 102, Pl. 17, and consists of a metal hand plate, fitted to the dorsum of the hand; a great feature of this instrument is the manner in which this hand plate is fitted. I have found it necessary to have the hand plate hammered to fit over the knuckles and prolonged a little beyond, by this means all undue pressure is avoided, and a perfect hand plate obtained. According to the contraction, mechanism for the fingers is attached to the hand plate, composed of short levers, connected by rack and pinion movements. These are attached to the hand plate and gentle extension obtained by binding the fingers to the levers by small narrow silk straps. A rather rare condition of contraction is to find the phalangeal without palmar. These are rather difficult cases to which to adapt apparatus, and I have found it necessary to carry the hand plate round in the form of a wing piece to catch the head of the first metacarpal bone and act as counter-pressure. The treatment by extension generally lasts three weeks, after which time a retentive

Extension Apparatus for severe Contractions.

splint is used to relieve the patient from the heavier extension instrument. It is generally found necessary to employ

Palmar Splint.

the palmar splint, represented, Fig. 103, Pl. 17, in which, by covering the whole of the palm with the plate, much greater fixation is obtained and more extension force given to the finger than by the smaller splints already described.

Mr. Adams' Retentive Splint for Phalangeal Contraction.

As an exceedingly simple retentive apparatus, Mr. Adams has recently designed a very perfect little splint for phalangeal contractions. It is composed of a formed piece of metal extending from the end of the metacarpal bone to the top of the finger involved (generally the fourth or ring), the palm portion is slightly enlarged to give a diffused bearing, and the finger portion made trough-shaped opposite the third articulation of the phalanges. This trough prevents any lateral displacement of the finger, and the retention of the finger is obtained by a strap and buckle passing over the first phalanx, and to which strap a small dorsal pad is attached; by the use of this pad a constriction of the finger is avoided, and the venous circulation unimpeded. The splint is attached to the wrist by a narrow silk strap fastened to a stud. This splint is so easily applied that its use has become very general.

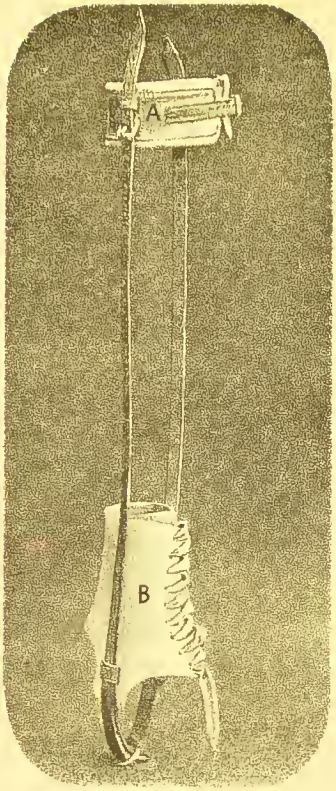


FIG. 104.

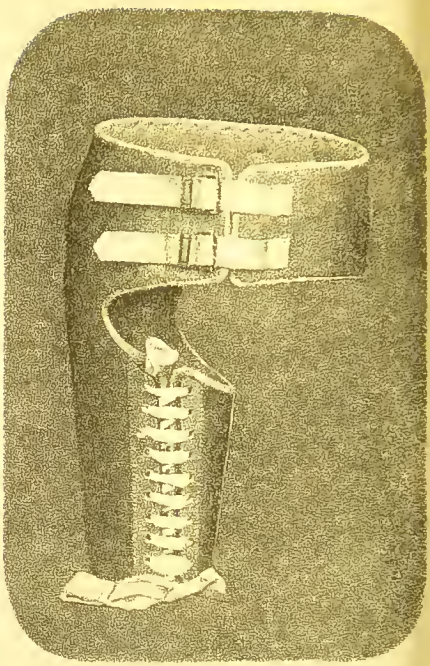


FIG. 106.

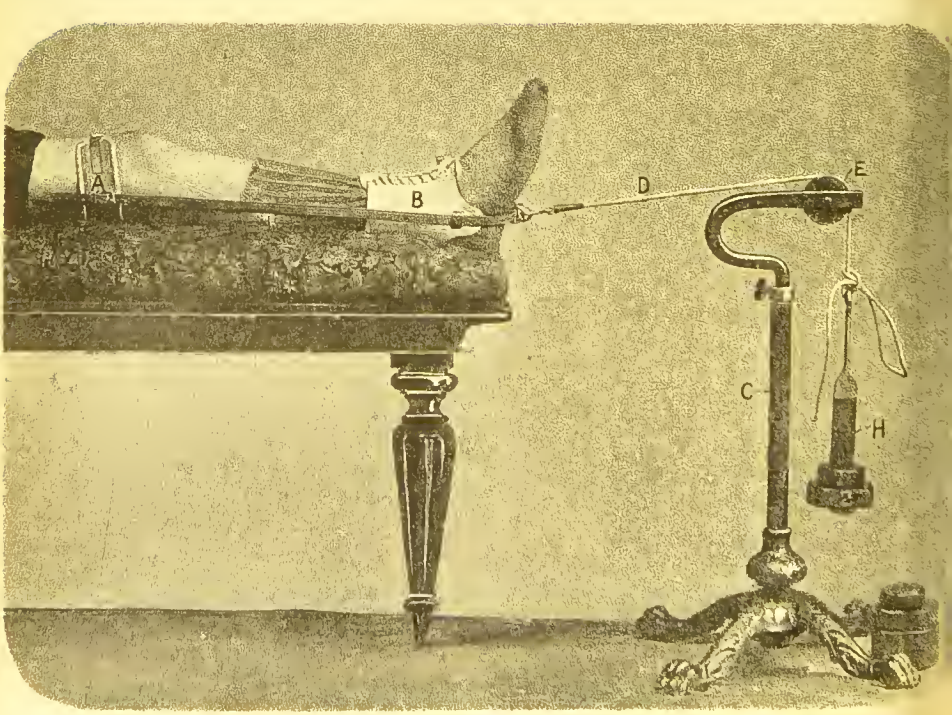


FIG. 105.

CHAPTER VI.

APPARATUS FOR HIP JOINT AFFECTIONS.

The appliances required for the affections of this joint are classed under three heads: those for disease, those for contraction, and those for congenital dislocation.

Thigh bandage and gaiter for extension.

In the first division, and in the acute stage, extension is usually applied, and I have illustrated at Fig. 104, Pl. 18, a thigh bandage A and gaiter B of the best form; the gaiter is adapted to take the strain from the dorsum of the foot, and is connected to the thigh bandage, which is fastened to the leg above the condyles of the knee joint. By their combined use the tension is diffused, and the weight acts more directly on the hip joint.

Weight Extension Apparatus.

In Fig. 105, Pl. 18, I have shewn the weight extension as adapted to the limb by my method. The thigh bandage A and gaiter B are attached to the leg. The weight-stand C (which is capable of adjustment according to the height of the bed or couch) is placed at the foot of the bed. The cord D is attached to the ring of the ankle bandage, passed over the pulley E and attached to the weight carrier H. The weights are made detachable, so that the amount of traction may be diminished or augmented at will. In many cases a "swan-neck" pulley is attached to the bedstead, dispensing

with the weight stand, but with the latter it is possible to move the patient from the bed to the couch, utilizing the same apparatus. Fig. 107, Pl. 19, shews the well-known Thomas's Splint, the application of which is already so generally understood. I have lately improved these splints by making the thigh and calf bandage to extend and entirely encircle the leg, with a softly padded leather bandage. This partly dispenses with the entire bandaging of the limb.

Thomas's Splint.

Blocked Leather Hip-Splint.

A very convenient form of rigid splint is the blocked leather splint, Fig. 106, Pl. 18. This is also well-known, and needs no detailed description. I have, however, frequently made the splint of poro-plastic with the advantage of rapidity of application and quickness in the completion.

The Sayres' Hip-Splint.

The Sayres' hip-splint, Fig. 108, Pl. 19, has been used with some success in this country. It consists of a strong pelvic band A to which is attached a rod on the outer side, with a platform joint at the hip B. Just below this joint abduction is made by a lateral screw C the counter extension is obtained from perineal bands E E attached to the pelvic band. Rotation is obtained by mechanism at F. The extension is made by a rack arrangement below the knee, and indicated in the diagram where the key is projecting H. The extension is controlled by a catch spring above the key, which is fastened by a sliding ring. Before extension is made this ring must be pushed back, and, after the limb is extended, the ring is slipped down and keeps the sliding rack in position. I have lately improved this splint by the adaptation of a ring catch joint at the knee, permitting the fixation or flexion of this joint at will.

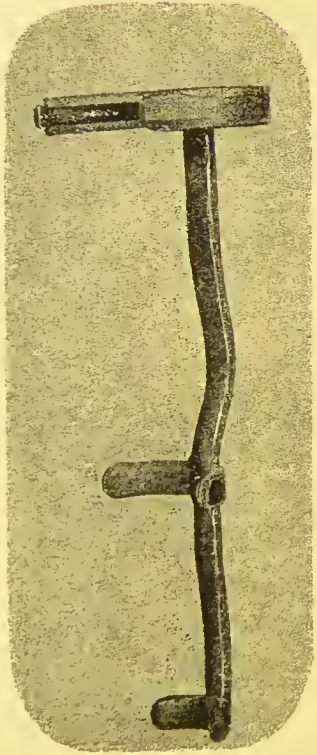


FIG. 107.

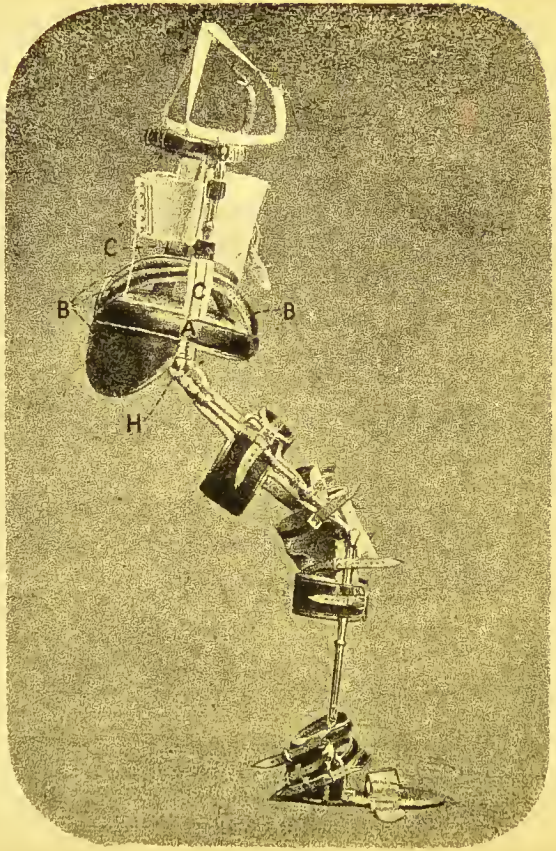


FIG. 109.

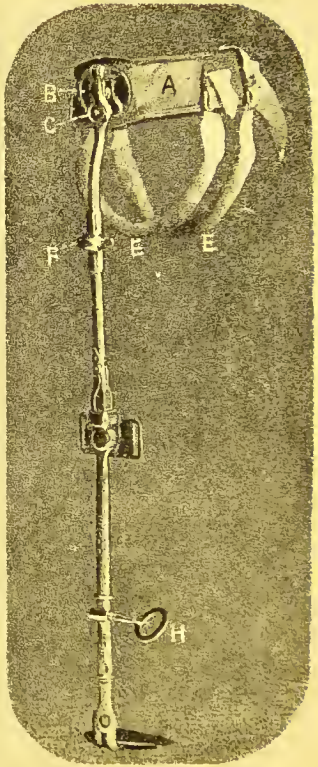


FIG. 108.

The principles of this apparatus are not new, but the mechanical adaptation possesses several novel features.

Contracted Hip Joint.

In cases of contraction of this joint it is necessary to use rather a formidable apparatus. The spinal part which creates this formidable appearance is very essential. In the first place the leverage from the hip joint to the pelvis is so exceedingly short, and in the second place considerable lordosis is always met with in these cases. At the same time this lordosis is extensively caused by the contraction, and by extending the point of counter resistance to the axillæ, means are given for the relief of this curvature. Fig. 109, Pl. 19, represents my apparatus which I have found most suitable. It comprises a pelvic band A with sacral plates and hip-pieces B B which form the fulcrum, to this pelvic band side crutches C C are attached with arm pieces, taking their point of pressure at the front of the axillæ. Webbing buckling pieces are attached from either crutch passing over the thorax and upper part of abdomen to give greater resistance to the extending force, and correct the lordosis. The apparatus is continued to the foot by a metal stem corresponding to the axis of the leg. This stem is fitted with a free joint at the knee and ankle, giving freedom of action to these joints. The principal mechanism is that fixed at the hip joint H and is in the form of three rack and pinion movements, (1) lateral or abduction, (2) flexion and extension, and (3) rotation. By these it is possible to adapt the apparatus accurately to the limb, and then gradually extend the leg into its normal position. This apparatus is generally used after tenotomy, and is applied three days after the operation.

Ernst's Apparatus for Contracted Hip Joint.

Congenital Dislocation of the Hip Joint.

The treatment of congenital dislocation or congenital malformation of the hip joint has within the last few months attracted great attention, firstly from the want of treatment which has hitherto prevailed, and secondly from the reported cure of a case by Dr. Buckminster Brown, of Boston. This case has been published in a monograph, in which he describes the nature of the treatment. This has been carried out by extension, and he illustrated the method by the adaptation of various weight stands, presenting rather a cumbersome arrangement. Whether the plan of treatment will eventually succeed yet remains to be determined; but I will here describe a couch that I have designed at the wish of Mr. Adams, which in itself is an entire departure from anything yet attempted. It has now been applied to five cases of congenital dislocations, and up to the present has fully answered all expectations. On referring to Dr. Buckminster Brown's book, it will be seen that the patient was kept in bed during the treatment, and this is one of the principal points objected to by Mr. Adams, on the score of the maintenance of the general health. I have therefore devised an extension couch, which contains the following features:—

1. A couch in which the extension principle shall be self contained.
2. Method by which abduction can be made without diminishing or increasing the extension.
3. Alteration of position of the patient without alteration of extension.
4. Capability to remove the patient from one room to another, or into the open air, without altering the position of extension on the couch.

Before detailing the manner in which I have obtained these important results, I would mention how well this couch is adapted for cases of hip joint disease (two have already been used with great success) and also in cases of cervical disease. In the latter class of cases it would simply be necessary to attach a standard and cross piece with head and chin strap to the upper part of the couch.

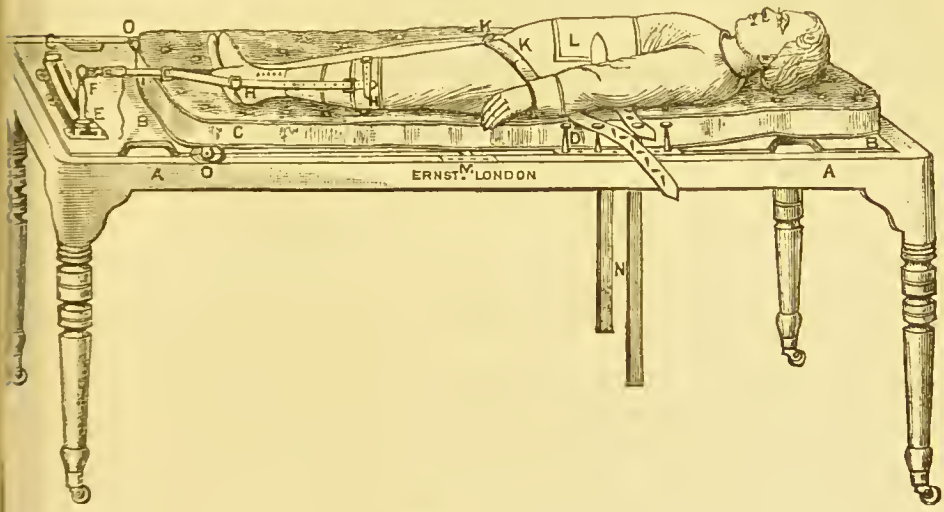


Fig. 110.

Extension Couch for Congenital Dislocation of the Hip joint.

Fig. 110 gives a general view of the couch. Its base is a frame A A with screw legs. The top of this couch B is entirely separate from the frame, is covered with a mattress C and is pivotted in the centre on two gun metal pins M. These pins are fixed to the frame, and work on gun metal arches, fitted to the under side of the top board. Sliding guides N are attached to the top board, and work through slotted pieces fixed to the frame, having a set thumb-screw in each.

Fig. 111 represents the plan of the extension mechanism. The counter-extension is taken from the perineum by two perineal straps K K made of India rubber tubing, these

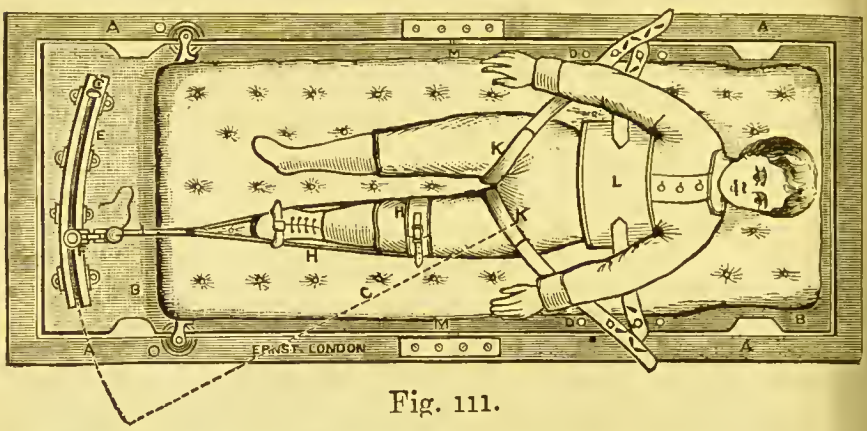


Fig. 111.

cleaner and more adjustable than the padded form. A chest band L is attached to keep the child from moving. Both the chest band and perineal straps are attached to studs D D on either side of the couch. The extension is made by the thigh bandage H and gaiter H of Fig. 104, Pl. 18. This is connected by a cord to the standard F which has fixed at the upper part one of the checks, already described, Fig. 73. The salient point here is the quadrant movement E. The standard F is fastened at its lower part to a flat sliding piece, which moves in the quadrant up to the distance of the thumb-screw G; by this means it is possible to bring the standard to the extreme point in the dotted line, giving the full abduction of the limb if requisite. As this quadrant is an arc with the radius emanating from the hip joint it is apparent that in abducting the limb, no loss or increase in the extension power takes place. The thumb-screw G is fixed at whatever position it is desirable to keep the standard.

Fig. 112 explains the altered position gained by the tilting arrangement. This permits the child to be fed in a better position than the horizontal, and also enables the child more

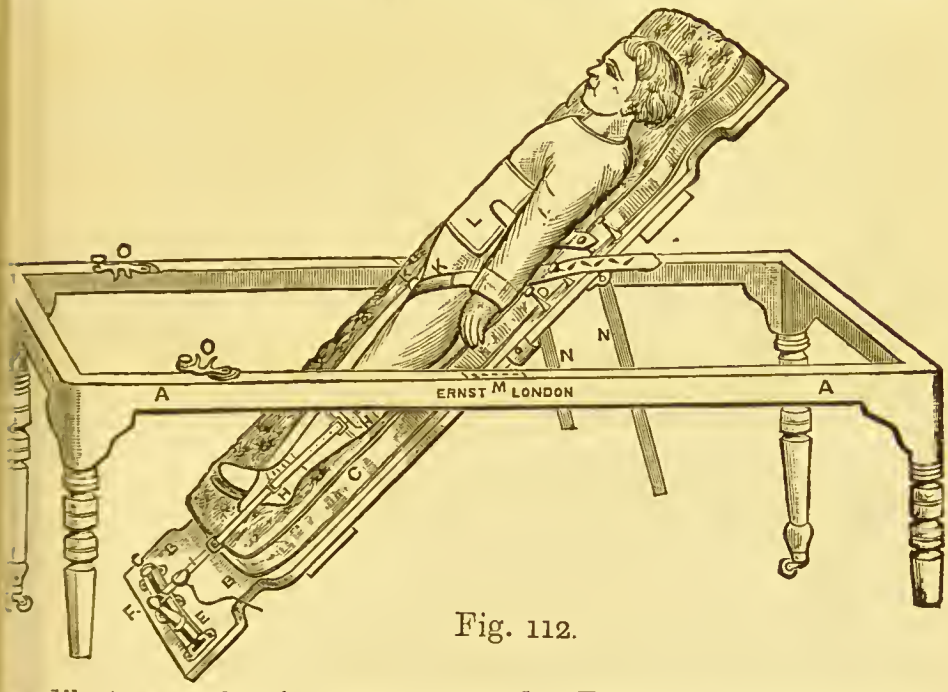


Fig. 112.

readily to see what is passing around. The angle of tilting can be regulated by the thumb-screws attached to the sliding guides M N; but before placing the child in this position, it is necessary to fasten the chest band L and unfasten the carriage catches O O. The next important point gained in this couch is the facility with which the child can be moved into the open air. This is an obvious advantage in the treatment in as much as no change of position in the joint takes place during the removal and it is also of great importance on the score of general health. In the cases already under treatment the patients have used the ordinary spinal carriage with long tray, into which the extension board has been placed, the patients covered with an apron, and little notice attracted. On reference to Fig. 111, it will be noticed

that "hand ways" are cut at the upper and lower end of the board. These are necessary for the removal operation which is performed in the following manner. One person stands at the head, and another at the foot of the couch, holds the board firmly, tilting it slightly, and then draws the "sliding guides" N out of the sockets. By referring to the illustration Fig. 113, the method of detachment will be clearly understood.

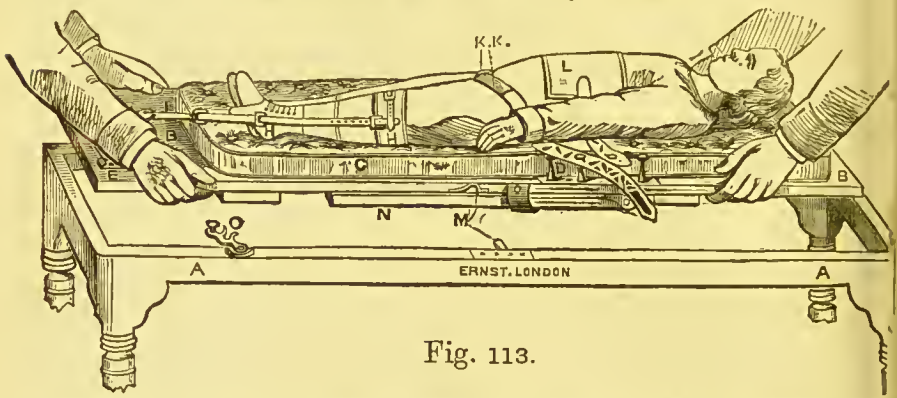


Fig. 113.

The gun metal arches M are regulated so as to permit the tilting and easy removal, their shape explains the plan. It is now only necessary to fasten the "sliding guides" up to the couch by leather straps, and the board is complete for out-door transport. In the cases under treatment the patients live in this position. The couch is fitted with a horse-hair mattress, and at night a blanket and sheet are carefully placed between the child and the mattress, this can best be accomplished by one person holding the child under the axillæ, and extending gently whilst the perineal and chest straps are unfastened, and the "bed" made. In washing it is necessary to place a mackintosh cloth over the entire mattress. The treatment principally depends on rest, and the maintenance of the limb in an extended position. This is easily accom

FIG. 114.

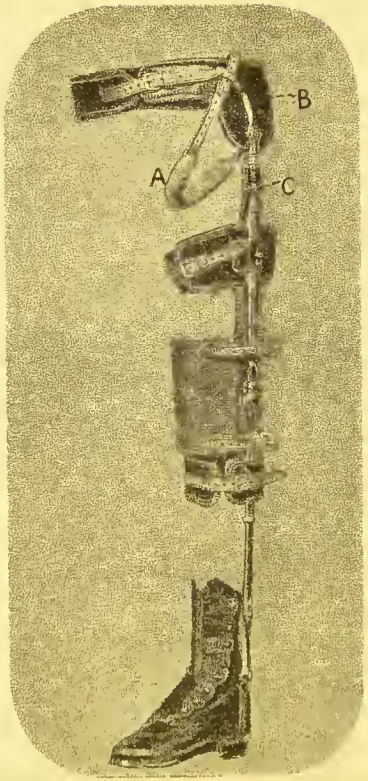


FIG. 116.

FIG. 115.

plished, for there is no existing contraction, and it is only when the patient stands that the elongated capsular ligament permits the rising of the limb, and consequent shortening; the extension force is therefore very slight, and only sufficient to keep the limb in unison with the other. The five cases under treatment have been those of three single dislocations, and two double; in the latter I added another quadrant movement with gaiter and thigh bandage. I would mention that the legs of the frame are made to unscrew, in order that it can readily be taken from place to place. I am enabled to give a very good illustration of a typical case of congenital dislocation, Figs. 114 and 115, Pl. 20. The lordosis is well marked, and the widening of the pelvis due to the position of the heads of the great trochanters clearly shewn.

Walking Apparatus for Congenital Dislocation of the Hip Joint.

In cases where the preceding treatment cannot be adopted, or possibly only partial recumbency and extension carried out, it is advisable to have some form of walking apparatus which shall maintain as much extension as possible during the day. I have recently seen a case of single dislocation where this description applies, and I have designed a light walking instrument with extension to meet the requirements of the case. Fig. 116, Pl. 20, represents this instrument made for the left leg. In this particular case I found on measurement that the limb was fully one inch shorter than the right, and that the patient was wearing a boot with one inch cork sole. This instrument was constructed with a pelvic band and counter extension perineal strap A. A cupped piece of leather B fitted over the head of the great trochanter which, was very prominent when the weight was borne on the leg.

The extension movement was adapted immediately below the hip joint C and the apparatus was fitted with a ring catch movement at the knee. I applied the instrument in the horizontal position, and after the straps were fastened I made extension to the extent of half-an-inch. A corresponding amount of cork sole was all that I placed in the boot, and when the patient walked it was with an appreciable difference in the gait and much less lameness. This apparatus was extremely light and caused no discomfort to the wearer. I

Walking Apparatus after treatment of Congenital Dislocation by the Extension Couch.

am enabled to give a very good illustration of the walking apparatus I have designed for Mr. Adams after the formation of the socket by the extension treatment. This instrument has been very successfully applied to two of the cases which have now been two years under treatment. It is represented, Fig. 117, Pl. 21, and is a combination of the Thomas's and Sayres' plans supplied with my mechanism; the apparatus contains an extension and counter extension principle A A B which will be readily understood on reference to the illustration. The right leg, for which the instrument has been constructed, is kept one-and-a-half inches from the ground, whilst the left leg is raised by a boot with a one-and-a-half inch cork sole, the little patient commencing to walk with the aid of crutches. Practically speaking, for the first few months, the whole of the weight of the body is borne on the tuberosity of the ischium, in order that the hip joint may become thoroughly brought into use, the height of the opposite boot is gradually lessened until both feet are placed equally on the ground. It should be mentioned that before this apparatus is applied, a strong leather belt

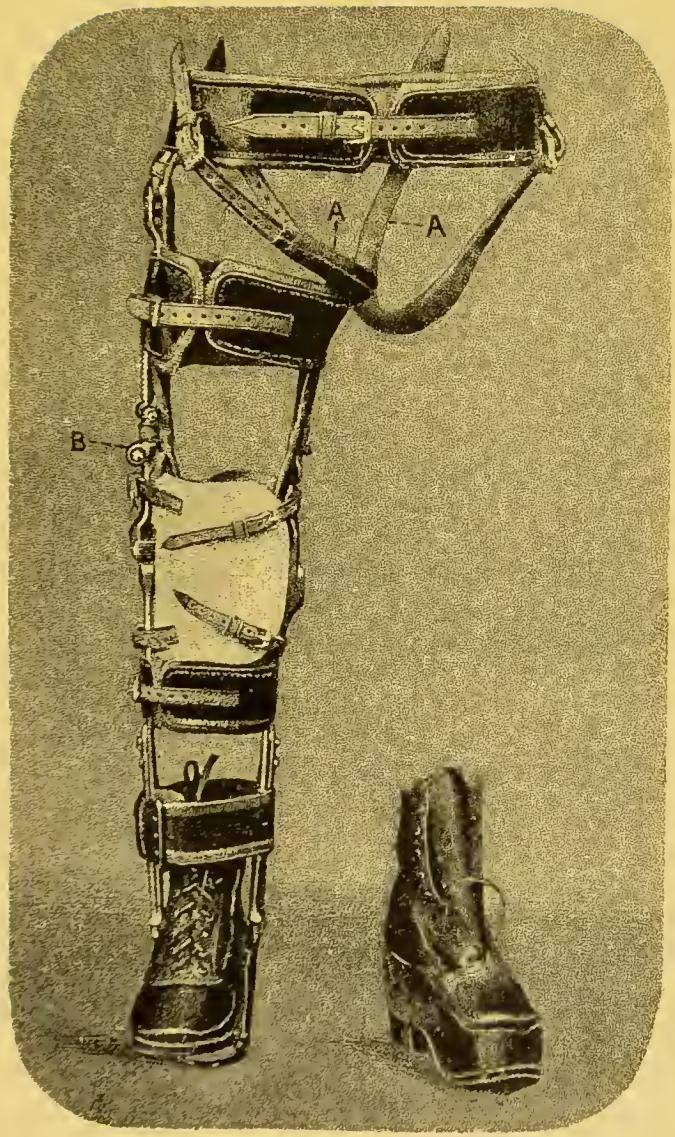


FIG. 117.

three inches wide, is attached around the pelvis, with a thick egg-shaped pad fixed to make pressure directly over the head of the great trochanter.

Leaden Clog for Extension.

As an adjunct in the treatment of congenital dislocation of the hip joint by extension, the leaden clog, Fig. 118*a* will be found very serviceable. It is usually worn outside the boot, varying in weight from two to ten pounds, and used in conjunction with the single trapèze-bar. It is apparent that in exercising with this clog the limb is extended at the same time that exercise is given to the muscular system.

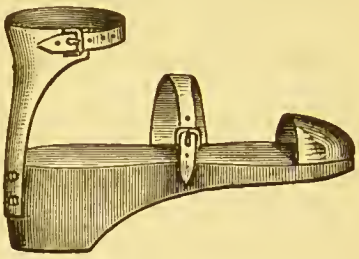


Fig. 118*a*.

Ernst's Abducting Saddle-Horse.

The abducting saddle-horse, Fig. 118*b*, I have designed with the object of gradually extending the

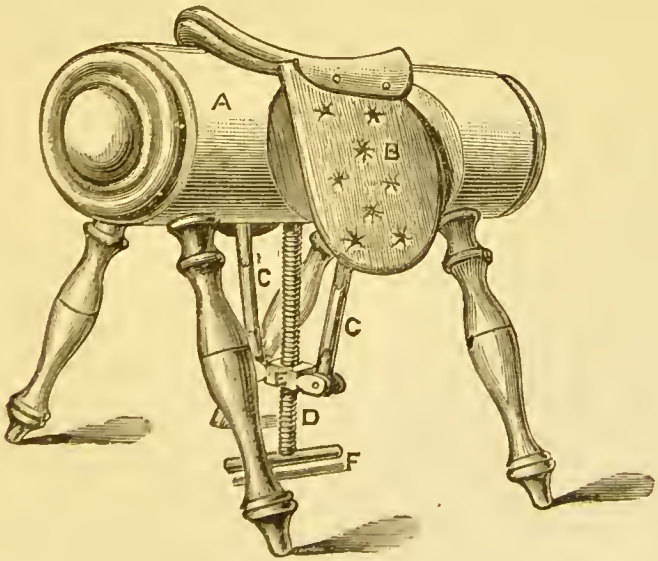


Fig. 118*b*.

lower extremities in cases of contraction of the adductor muscles, without the application of special mechanism to the limbs themselves. This end is gained by the patients sitting on an extending saddle, having mechanism by which gradual separation of the hip is effected a certain number of hours during the day. The horse A represents the base to which the saddle and flaps B are attached. The extension mechanism is derived from the long screw D passing through the carrier E which is in turn affixed by jointed connecting levers C C to the saddle flaps, the degree of extension being regulated by the handle F.

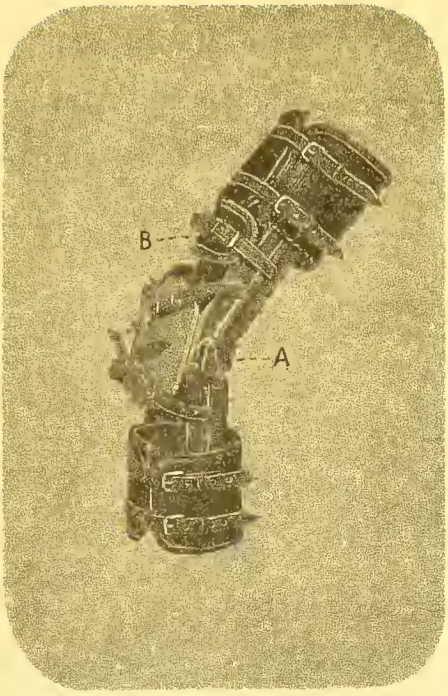


FIG. 120.

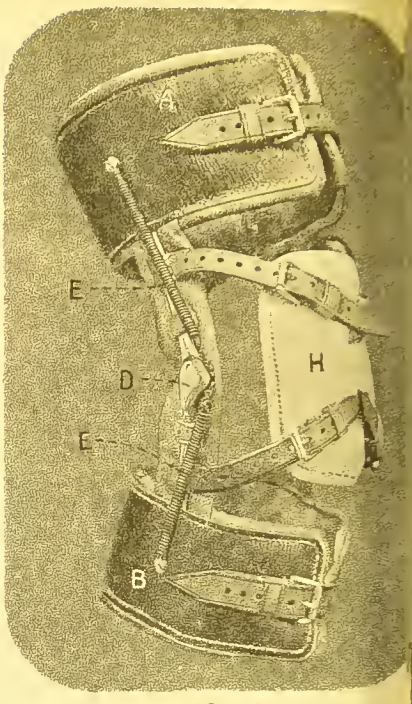


FIG. 119.

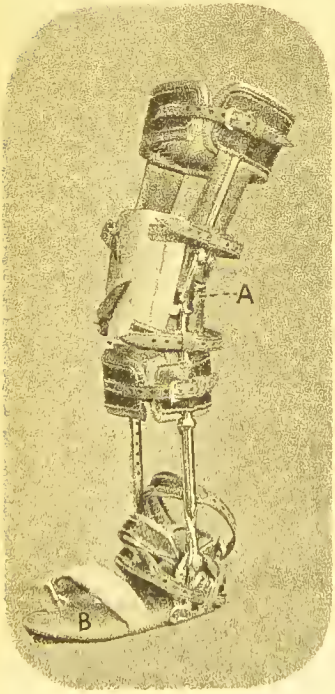


FIG. 121.

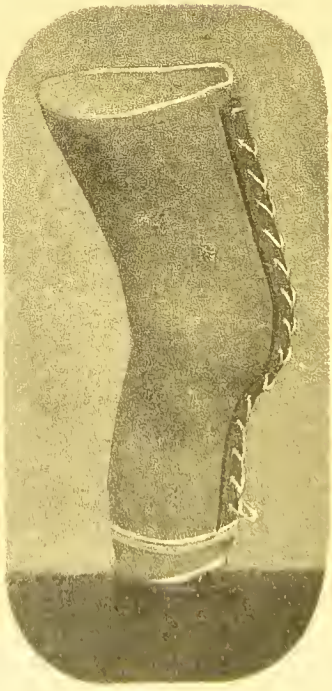


FIG. 118

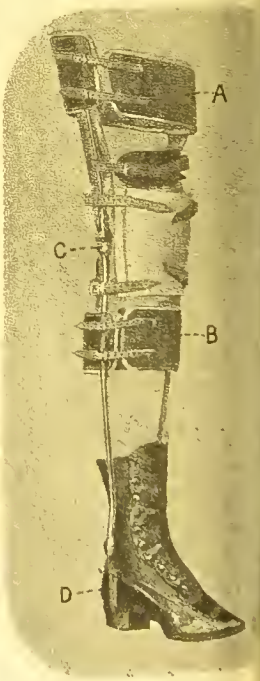


FIG. 122.

CHAPTER VII.

APPARATUS FOR KNEE JOINT AFFECTIONS.

The apparatus for this joint may be classed under two heads, viz.: those for "contractions and displacements" and "paralytic affections." I intend to detail the several apparatus for paralysis of the lower extremities in a separate chapter, I shall therefore only describe here the instruments for the former class.

Blocked Leather Knee Splint.

The simplest form of splint, the blocked leather, is illustrated, Fig. 118, Pl. 22, and is suitable in cases of anchylosis, excision, and contraction after disease, etc. It is well known in construction, and need not therefore be explained. I must mention that I have found it sometimes rather heavy when of adult size, and have very successfully substituted poro-plastic in its place. This can be made with a soft strip of felt running through the entire length of the splint at the back, and, acting as a hinge, enables the splint to be easily applied without jerking the limb. In addition, the part over the patella can also be left soft, and thereby prevent any pressure on that often highly sensitive spot.

Apparatus for Fractured Patella.

In cases of fractured patella, I have found the subjoined apparatus, Fig. 119, Pl. 22, very beneficial. In such affections it is not usually applied until after union, and is generally used as a walking instrument, but is also of great benefit where non-union exists. It consists of a thigh and calf bandage A B connected

along the axial line by metal stems D and jointed at the knee centre. The joints are made with limited motion for commencing movement, and increased gradually, according to the necessities of the case. The chief factors of the instrument are the spiral springs EE connected over the joint by a metal chain, this plan of giving assistance and support is infinitely superior to the elastic webbing band passing over the knee, for in the latter mode the pressure on the patella increases as the knee is flexed. In my method of support an equal bearing is obtained from the knee cap H which is made of a soft adaptable material. When non-union exists it is necessary to add an above and below pressure strap; these straps are fastened respectively to the lower and upper stems of the instrument with regard to the joint of the apparatus. As the knee is flexed, the action of the straps is to tend to draw the fragments of the patella together.

Apparatus for Dislocated Patella.

The cases of dislocated patella are somewhat rare, and present some difficulties in the application of mechanism. I have recently had a case of this nature (congenital) to which I have successfully fitted the apparatus here described. Figs. 123 and 124, Pl. 23, shew the condition of the patella when the knee is straight and flexed. In the latter figure the lateral dislocation is well marked. A similar instrument to the preceding was applied; but the notable feature consisted in the crescent-shaped supporting plate A Fig. 125, Pl. 23, which was adjusted closely to the limb, and which effectually prevented the dislocation of the patella. In this appliance I obtained this desired result by attaching the supporting plate to the stems of the leg instrument which fol-

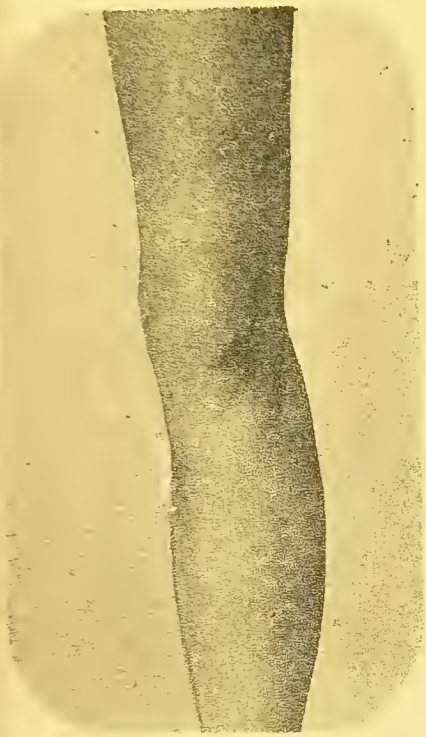


FIG. 123.

FIG. 124.

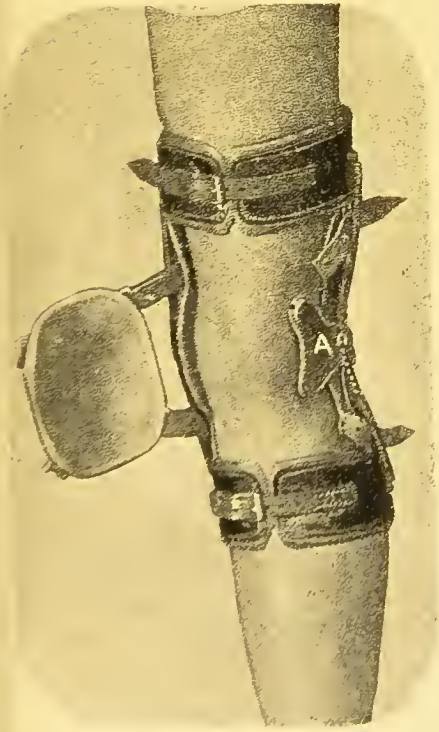


FIG. 125.

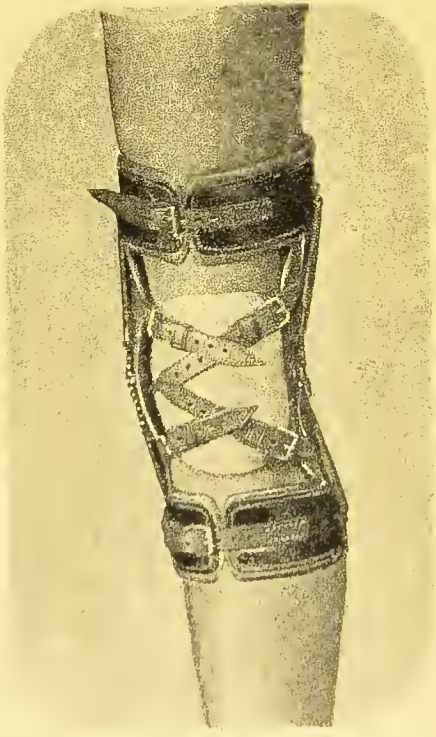


FIG. 126.

wed the axis of the leg in flexion. Fig. 126, Pl. 23, shews the pparatus finally adjusted. Occasionally a truss is applied to iese cases, but owing to the alteration of the contour of the leg, pecially behind the joint in flexion, it is of little use.

Apparatus for Displaced Semi-Lunar Cartilage.

The apparatus for the retention of the semi-lunar cartilage is similar to the preceding with the addition of a winged plate which is fixed to the side-stem, and dapted over the spot where the cartilage displaces. This wing fastened according to the condition of the displacement hether internal or external.

Simple Knee Joint Extension Apparatus.

In cases of ordinary contraction of the knee it is usual to employ the apparatus illustrated, Fig. 120, Pl. 22. This instrument is suitable for simple contraction; it is comprised of two short side-stems, below and bove, connected at the knee by a single action rack and inion movement A. This enables the adjustment of the instrument to the bent position of the leg and the subsequent gradual xtension. The essentiality of all knee joint extension instruments is the extra pressure strap B which is buckled round the side-:ems and enables the pressure of the knee-cap on the patella to e diminished without hindrance to the efficiency of the appliance.

Knee Joint Apparatus for Severe Contraction.

In severer cases of contraction where inversion of the limb also exists, it is necessary to have rather a more complicated apparatus, Fig. 121, Pl. 22, with ouble side-stems extending from the thigh to the ground. he mechanism at the knee A is a double action rack nd pinion movement, flexion and extension, and lateral. The oint at the ankle is of the detachable type; for the attachment ither of the sole plate B for night (shewn in the diagram) or a

boot for day, it is advisable to extend the instrument to the foot, to obtain the necessary leverage to act on the lateral condition of the limb. The apparatus is usually applied four days after tenotomy, and first screwed to the position of the leg and then gradually straightened as the tendons re-unite and lengthen.

Walking Apparatus for Contracted Knee.

As an efficient walking apparatus, and especially in cases of contracted knee of a rheumatic origin, I have found that Fig. 122, Pl. 22, is well calculated to give a light and substantial aid in walking after extension treatment. Owing to the length of time that contractions of this nature usually exist, the limb is very weakened from want of use or other causes, and it is imperative to have a thorough support. The illustration typifies the requisite form of instrument, which has very light stems, extending from the ground to the thigh, on either side of the leg, and attached to the limb by a thigh and calf bandage A B; the mechanism at the knee being a ring catch joint C, and the apparatus is made detachable from the boot by a double box vertical side-socket D. From the illustration of the apparatus, which was made for a lady of rather large size, the lightness of the construction is very evident. In ordinary cases the preceding apparatus are very beneficial and quite sufficient, but in a great number of severer forms of contraction, backward dislocation of the head of the tibia exists in conjunction with the contracted knee. Many plans have been devised for this difficult combination, but the most efficient is that illustrated, Fig. 127, Pl. 24. This instrument was invented by my Father, and has been successfully used in many cases. The mechanism for the extensio

Ernst's Apparatus for backward dislocation of the Head of the Tibia with contraction of the Knee.

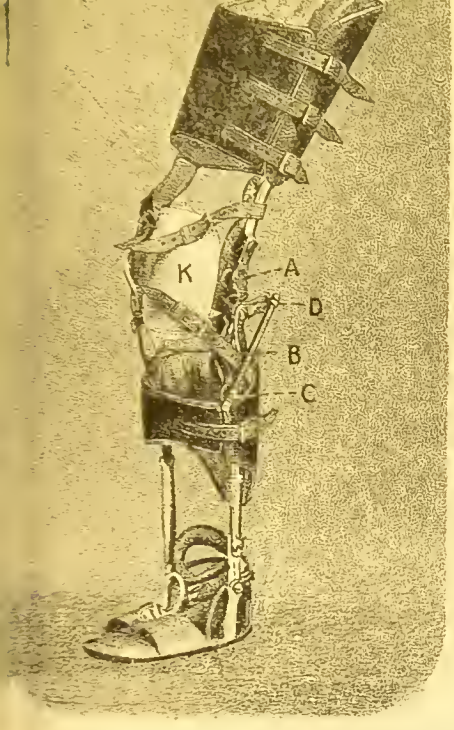


FIG. 127.

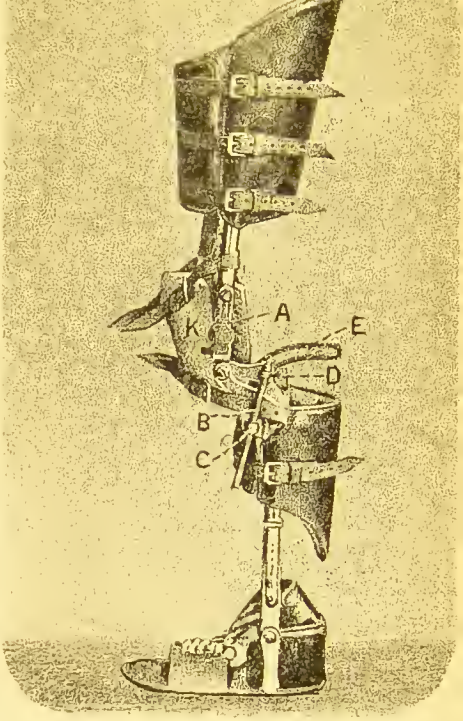


FIG. 128.

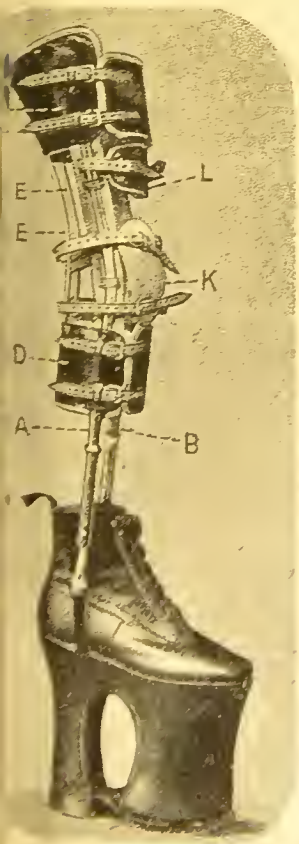


FIG. 130.

FIG. 129.

FIG. 130A

the knee A is the same as the preceding apparatus, but ıe method employed for reducing the backward dislocation is ıtirely original. It is obtained by means of a long screw B tached to the lower stems of the apparatus C the lower end of ıe screw being shaped into a "three-square" head. The upper end fastened to a swivel piece D attached to the double action rack, ıd travelling in a quadrant E this quadrant corresponding to the :c described by the head of the tibia in backward dislocation. ig. 128, Pl. 24, well shows the different axis assumed by the pper and lower portion of the instrument, and in this position ıe apparatus is first applied. In examining the nature of the ıechanism its perfect application is apparent; by the use of ıe quadrant a forward and downward motion is obtained and ıe upward traction to the knee is ensured in the application of ıe knee cap K.

Fibrous Anchylosis of Knee Joint.

In conditions of Fibrous Anchylosis of the Knee Joint after excision, I have often seen cases where contraction of the knee has rapidly taken place owing to the tate of the union. As a rule a leather or poro-plastic splint has een used, but for some patients recently sent to me, I have very uccessfully adapted the following apparatus, which is light, ıore effectual, and considerably more durable than the above ıentioned splints. I am indebted to the kindness of a patient for he illustration of such a knee, and the same with the instrument ı use. This case, Fig. 129, Pl. 24, was sent to me by a London ;urgeon about three years ago. The boot evidences that conıderable shortening of the limb resulted from the excision viz.: 6 inches), and although the patient was wearing an equally ıigh boot when he commenced walking, the knee was rapidly

contracting. At the time of my seeing him, the leg had almost flexed to an angle of 90 degrees, and it was necessary to have the assistance of a crutch in walking, in fact, latterly, the foot of the right leg had not been used at all.

Apparatus for Fibrous Anchylosis of the Knee Joint.

The apparatus is illustrated, Fig. 130, Pl. 24, which I designed with a double stem from the ground to the thigh A B *without* a joint at the knee, these stems are connected and fastened to the leg by a thigh and calf bandage C D. The important feature of the instrument rests in the back wires E E which are attached to the thigh and calf plates. The object of these wires is to increase the backward traction of the knee cap K and the extra pressure strap L. The instrument is therefore converted into an active apparatus, the result of which is seen in the illustration of the mechanism applied, Fig. 130a, Pl. 24, where the amount of contraction at the knee does not exceed 35 degrees.

Dr. Little's Apparatus for General Extension of Knee Joint.

Fig. 131, Pl. 25, illustrates Dr. Little's apparatus for general extension of contracted knee joint. This instrument is applied to cases where mobility exists with the contraction, and for this purpose the knee joint is provided with a ring catch movement A in addition to the rack and pinion movement B by this means facility is given for flexion of the knee when sitting. The employment of the crutch arrangement D at the perineum is very useful, and it is regulated by a small screw movement F adapted to the thigh plate. The purpose of this crutch is to remove the principal weight of the body from the knee joint, and through the side stems of the apparatus transmit it to the ground. The boot is detachable by the "bevelled morticed joint" H enabling

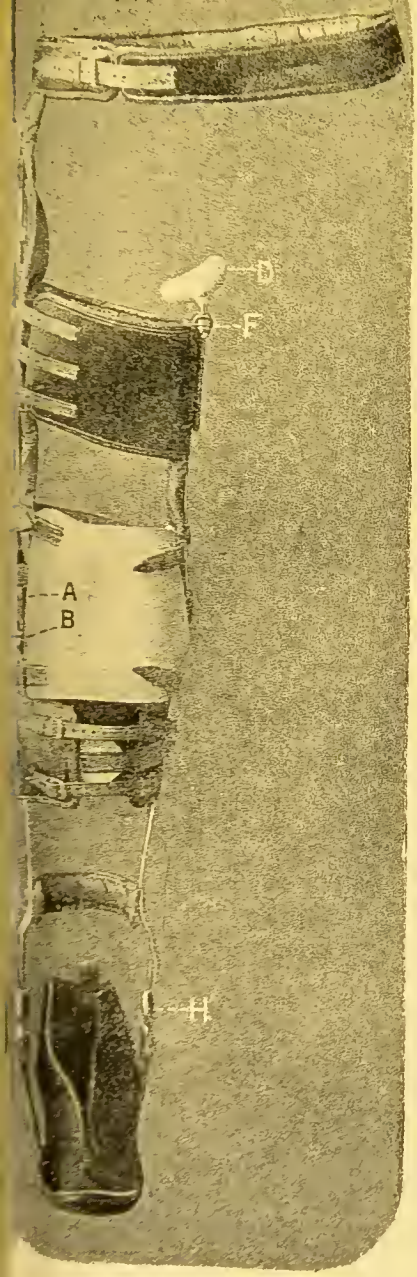


FIG. 131.

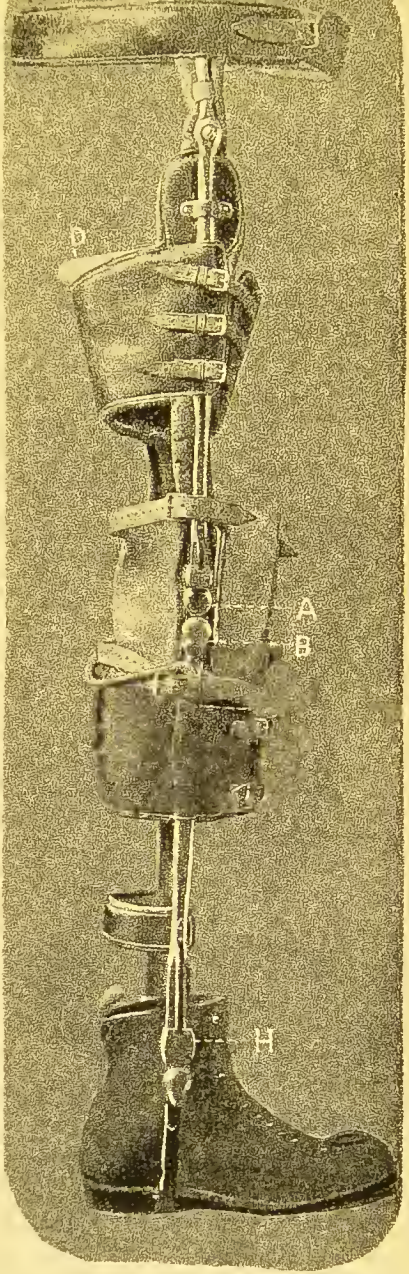


FIG. 132.

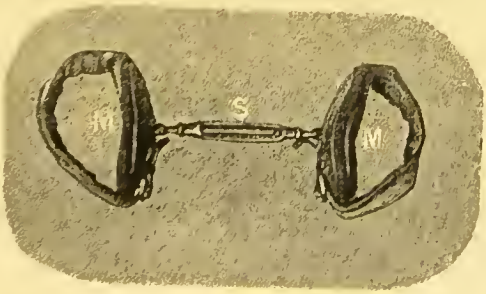


FIG. 133.

a shoe to be worn at night. Fig. 132, Pl. 25, gives a good side view of the mechanism.

Dr. Little's Extension Screw for Separation of Knees.

Fig. 133, Pl. 25, represents the extension screw of Dr. Little, for separation of the knees, resulting from contraction of the adductor muscles. It is constructed of two plates, encircling the limbs above the knee joint MM connected by an extension screw movement S which is easily regulated by rotating the double portion of the connecting piece. The plates are softly padded to prevent abrasion.

Apparatus for general Contraction of the Limb.

For cases of general contraction at the hip, knee, and ankle, the adaptation of the rack joint is well shewn at 1, 2, 3, Figs. 134 and 135, Pl. 26. It is advisable in these cases to give a ring catch joint at the hip 4 to enable the alteration of position necessary during treatment. The regulating perineal crutch is attached at A and provides an additional point of counter-pressure in overcoming the lateral condition of contraction. The sacral plates B are also useful as a means of counter-pressure for hip extension. It should, however, be mentioned that this form of apparatus for hip extension is only suitable to cases of slight contraction at this point. The preceding appliances form the principal description and adaptation of mechanism for the extension treatment of cases of contraction, but it is necessary to use walking apparatus afterwards.

Walking Apparatus after Extension.

Generally speaking, it is advisable to use the mechanism of the ring catch; and the instrument already depicted, Fig. 122, Pl. 22, is a good type of this class. Also the walking apparatus described for fibrous

anchylosis is suitable for cases where immobility exists after extension.

Genu-Valgum.

Many new methods have of late years been introduced in the treatment of genu-valgum, especially that of osteotomy, yet the old plan of mechanical treatment is still largely practised. That this latter treatment is successful cannot be denied. A short time since I saw a case where twenty-one inches marked the distance between the inner malleoli at the commencement of treatment, and which in the course of eight weeks was reduced to eight inches. As in all orthopædic cases, it is essential that the right form of apparatus should be selected. In slight cases, where there is only four inches separation of the malleoli the ordinary straight splint with knee cap is sufficient.

Straight Splint with Knee-cap.

It is necessary that the knee-cap should buckle on the under side of the splint, as the effect of fastening it in this position will be to keep the knee from rotating. If the knee-cap be buckled the reverse way, the knee is rotated outwards, and the leg assumes an apparently straight position, but on examination it is discernible that the patella is lying *in* the splint, and not on a level with the top edge. After the knee-cap is secured a bandage should be passed over the entire splint to keep the leg in position. When the deformity assumes a severe aspect, that is any measurement over four inches, it is necessary to employ the trough splint, Fig. 136, Pl. 26.

Trough Splint with Rack Movement.

This most efficacious instrument has been used in all severe forms of genu-valgum, and it is only in cases of exceptional rigidity that it fails to effect a cure. It is composed of an angular metal thigh and calf piece A B the

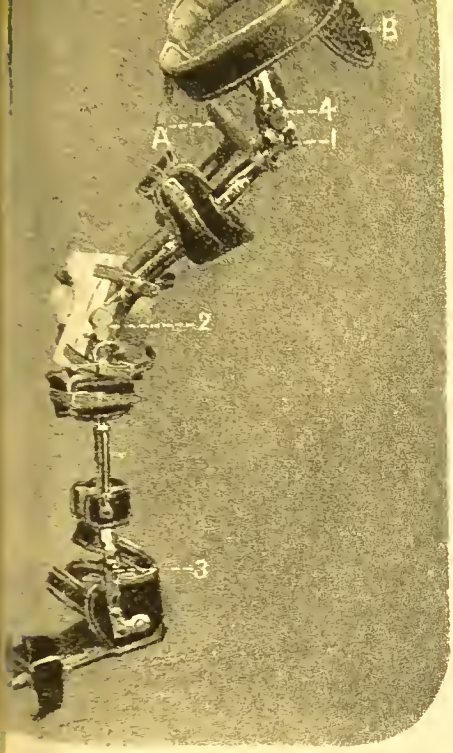


FIG. 134.

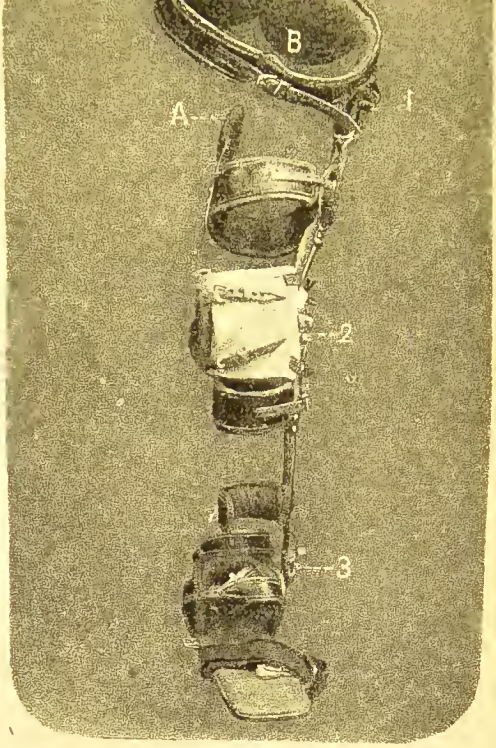


FIG. 135.

FIG. 136.

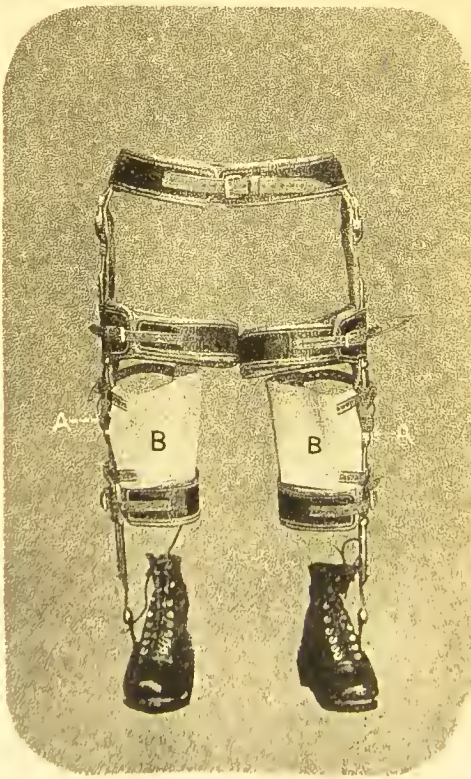


FIG. 137.

latter ending in a metal sole plate. The two pieces are jointed at the knee by a single action lateral rack movement E. The figure represents the splint adapted to an ordinary case. It is necessary to place the splint on the limb, in a rather more deformed condition than the case itself, and after the buckles have been adjusted, to make gradual extension with the rack joint. It is well to notice the following points: the leg and the splint should be in apposition during the treatment, and this will guide the medical man in the use of the instrument. After the splint is first adjusted and slight extension made, the part of the splint nearest the knee joint should be closely watched. If it be observed that the leg and the splint part company at this point, further screwing should be stopped, as the splint alone is moving. It is always advisable to go just to this extent and then slightly reverse the movement. This will ensure a perfect action, and give relief to the patient, should undue tension be experienced. After the treatment by either of the preceding appliances, it is generally advisable to have some form of walking apparatus, inasmuch as the limb has become weakened by inactivity or bandaging, more especially as in some cases the cure of the genu-valgum has been caused by the elongation of the external ligament, consequently resulting in a straight knee joint, but with ligamentous weakness.

Convex Spring Knee-Cap.

In the very slight cases of genu-valgum, where the long splint alone is sufficient, it is preferable to have some slight walking support, and this is admirably given in the spring knee-cap, illustrated Fig. 138, Pl. 27. It is made of a moleskin knee-cap A to which is fitted on the outer side a convex steel-spring B with the concavity towards the knee, this spring

being jointed at the centre to permit of free motion. In applying the knee-cap the object of the spring is evidenced by the position and manner in which the knee is drawn over to the spring and supported. In severer forms, greater support to the leg is requisite, and it is desirable to carry the apparatus from the ground to the thigh, if not to the pelvis. The reasons for this are firstly, that in these cases, owing to the general weakness, a much firmer support is needed, and secondly, that any apparatus applied to the knee alone, will either rotate or slip, it is therefore imperative that the apparatus should be adapted to the boot to keep it in position.

Walking Apparatus for Genu-Valgum.

Fig. 137, Pl. 26, shews the most suitable apparatus for these cases, it extends from the ground to the pelvis, with a free joint at the hips and ankles; at the knees ring catch joints A A are employed with broad buck-skin knee-caps B B; by the use of this material a better adapted knee-cap is obtained, and the patient enabled to flex the knee with perfect freedom. Not only is the ring catch joint advisable from the point of convenience, but it is an established fact that the condition of genu-valgum can only be reduced when the limb is fully extended, and therefore in this position any tendency to relapse can be corrected. The side stems are connected at the upper part by a pelvic band, and fastened to the legs by thigh and calf bandages. It is important at first to keep the "rings" down (the patient walking with stiff limbs) as in this position greater support is obtained.

Genu-Varum or Extrorsum.

It is not unusual to find in a case where one leg is in a condition of genu-valgum, the other is in that of genu-varum or extrorsum. The same apparatus

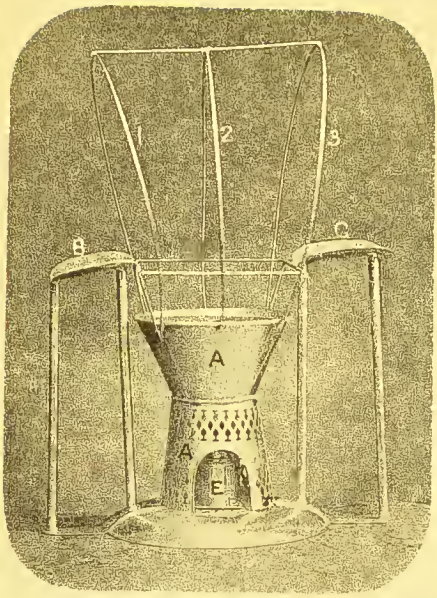


FIG. 139.

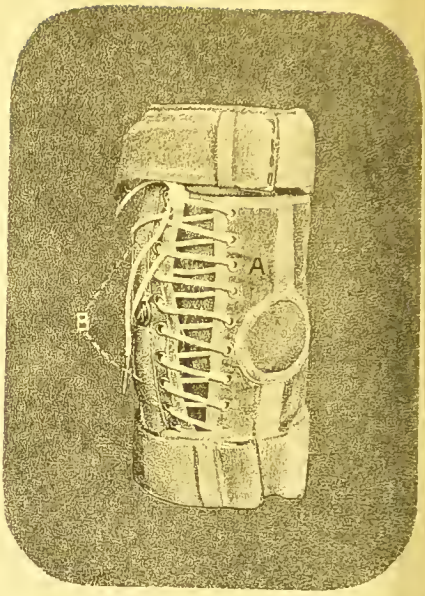


FIG. 138.

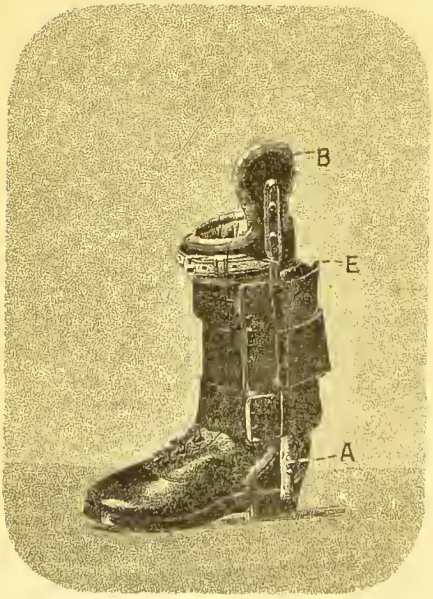


FIG. 140.

FIG. 141

are applicable to both, but it is of course necessary to reverse the position of the mechanism for the latter deformity.

Mr. Adams' Knee Steam Bath.

Whilst on the subject of knee joint, I would draw attention to the excellent steam bath (Adams') illustrated Fig. 139, Pl. 27. This is often used in cases of rheumatic contraction of the joint, and produces considerable laxity during its use. It is designed in the shape of a double conical stand A A, in the upper cone a pan of water is enclosed, covered over with gauze netting, which acts as a "spreader" to the steam, and retains any water which may spurt up whilst boiling. The limb is passed through the wire hoops 1, 2, 3, and the thigh and calf rest respectively on the plates C B. The whole is then covered over by a thick felt, effectually preventing the escape of steam. The heat is generated by the lamp E. There is no difficulty in using this bath as it is suited to the height of an ordinary bedroom chair. Not only in cases of contraction, but in the absorption of synovial fluid great benefit may be derived from its use. Before proceeding to my next chapter, on apparatus for club foot, I will describe the appliances generally used for curved tibia.

Short Splint for Curved Tibia.

In simple cases the ordinary short splint suffices. This is invariably bandaged to the leg on the *inner* side, and during its use the child should, if possible, be prevented from walking, as the splint is not strong enough to admit of this exercise. In many cases it is impossible to adhere to this rule. A child from 14 to 18 months of age is naturally anxious to get about, and consequently great difficulty is experienced in keeping it off its feet. In other cases the child's general health suffers from inactivity, it is then essential

to have a light steel apparatus for day use, and the splint at night.

Walking Apparatus for Curved Tibia.

Fig. 140, Pl. 27 describes the form of tibia instrument that I have invented, and which has been found most beneficial. It is made of an inner upright A extending from the sole of the foot to the centre of the knee joint, and inserted in the boot by a round socket. Although, in my opening chapter, I particularly drew attention to the inadvisability of using this form of socket, here no other form would be available. In the majority of cases the curvature of the tibia exists in the lower third, and often immediately above the ankle joint. I am therefore (by having an unbroken stem) enabled to bring the pressure immediately over the curvature. The upper part of the inner upright is connected to a counter-pressure plate B which takes a bearing on the inner condyle of the knee. Just below the calf-plate, a light wire E is attached to the instrument, extending along the median line of the leg at the back, and united again to the stem immediately above the ankle. The object of this wire is very important, it enables the straps to press entirely on the prominent point of curvature, and prevents that constriction of the leg which, without the wire, would take place. This instrument is suitable for cases of outward curvature of the tibia only.

Apparatus for Anterior Curvature of the Tibia Night and Day.

In cases of anterior curvature of the tibia more difficulty in the treatment is experienced, and it is necessary to continue this both day and night. I have recently had a rather severe case of combined genu-valgum and curved tibia, outward and anterior, for which I devised the following apparatus. Fig. 142 Pl. 28 illustrates the trough

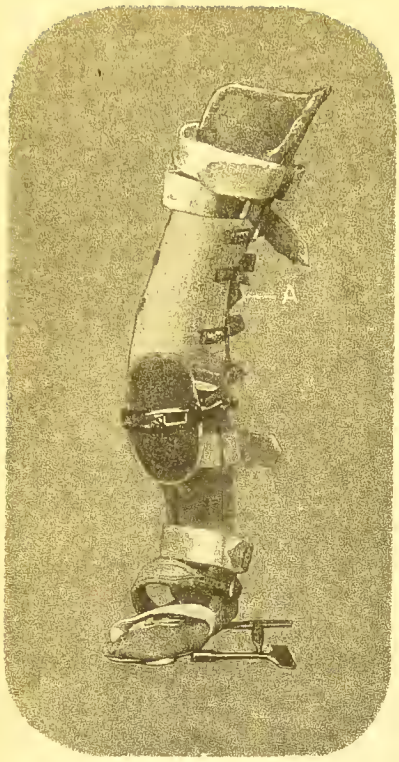


FIG. 142.

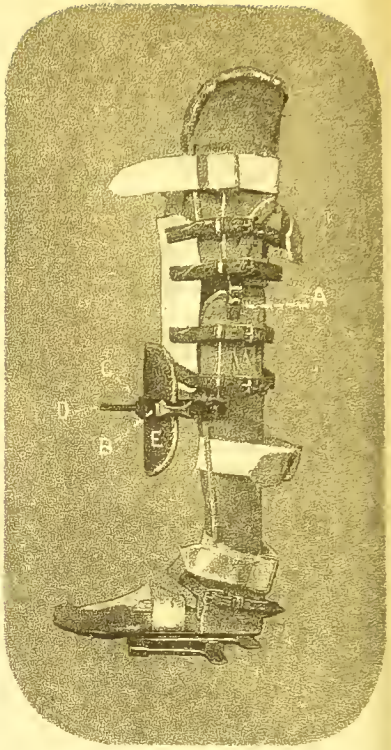
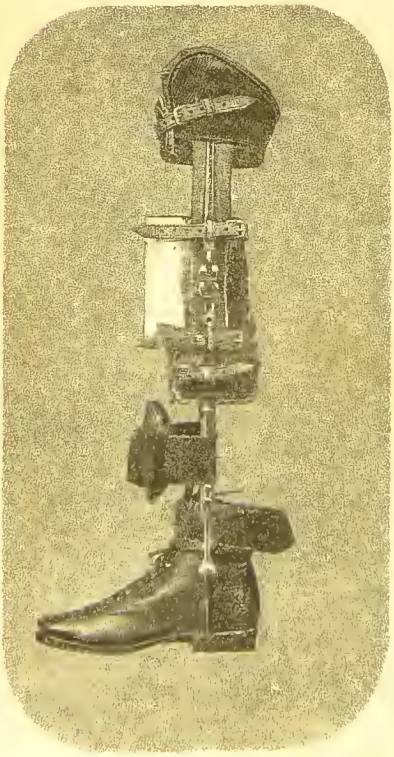
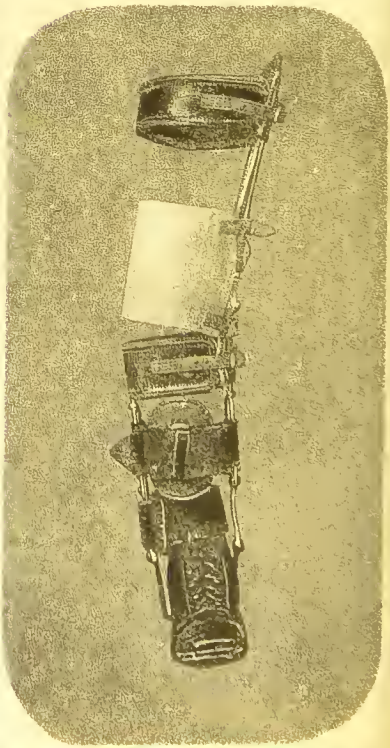


FIG. 143.





splint with rack movement at the knee A (this has been already explained). The principal mechanism for the tibia existed in a metal bridge B, Fig. 143, Pl. 28, fixed to the splint at a point corresponding to the centre of the curvature. In this bridge a "traveller" C is fixed, through which a pressure screw D passes, and to the end of which screw, a pressure plate E is attached. This bridge is hinged to the splint to admit of the insertion of the limb. The pressure plate E is very carefully padded at the sides only, so as to prevent abrasion of the skin on the prominent ridge of the tibia. Figs. 144 and 145 Pl. 28 shew the walking apparatus in which a lateral rack is added to the ring-catch to compensate for the degree of genu-valgum. In place of the screw arrangement for downward pressure on the tibia, I have introduced the extra pressure strap fastened round the uprights of the instrument. The night instrument is extremely powerful in action, and it is necessary to use the screw movement with very great caution, otherwise it will produce a sore.

Mr. Roeckel's Apparatus for Anterior Curvature of Tibia.

Mr. W. J. Roeckel has suggested an improvement on this form of apparatus for anterior curvature, which is especially efficient in use, and where the screw regulating movement could not be trusted in inexperienced hands. Fig. 141, Pl. 27 exemplifies the instrument I have recently constructed for him. The double upright form of instrument has been adhered to, but the uprights from above the ankle joint to the calf-plate have been set back, to give greater leverage in fixing the pressure pad. This pad is formed of a metal plate, with india-rubber air-pad attached, two broad leather straps, one on either side, are secured to the sides of the

plate, and these pass round the side uprights and are fastened to a buckle fixed to the pad. The pressure gained by this means is very great, and by the use of an air-pad undue strain is not experienced. These air-pads are furnished with a stop-cock so that by means of a small inflator they may be constantly kept charged.

CHAPTER VIII.

Talipes.

The generic term Talipes is applied generally to those cases of deformity of the foot, which is commonly known as Club Foot. This class of cases is divided into different degrees of deformity, and are either of a congenital or non-congenital nature. Many operations of osteotomy for the cure of Club Foot have been introduced of late years, but as my experience is entirely among the cases of tenotomy I shall only describe the appliances which have been found useful and necessary in that treatment. The desirability of removing a wedge-shaped piece of bone from the foot has been very ably advocated, and the operation successfully performed, but as the cure of the most severe forms of talipes equino-varus without osteotomy is of frequent occurrence, I venture to describe rather fully the apparatus used in the treatment. The mechanism applied has often been condemned as "useless screws and springs," but this verdict I shall endeavour to dispose of by the illustration of a case cured by the use of appliances in conjunction with Tenotomy. By this I do not mean to say that the appliances alone are the means of cure, as without the operation the instruments would be valueless, and *vice versâ*, nor am I egotistical enough to refer to my own instruments only, but all those that are properly constructed.

I frequently see cases where the operation has been well performed, but the after treatment a failure owing to the use of imperfect mechanism. Undoubtedly the successful issue of these cases depends in a great measure on the apparatus and their use, and so long as the old forms of instruments are adhered to and continued, so long will a comparatively few brilliant results be the exception rather than the rule.

Pathologically viewing these cases the treatment must extend over a certain time. The tendon after division does not unite till the fourth day, and occupies from three to six weeks in regeneration. It is during this process of regeneration or lengthening that it is so necessary to use some form of apparatus in which the gradual extension of the foot can be made. The Scarpas shoe, or more properly either Little's or Adams' shoe, are the only perfect forms hitherto designed for this purpose. In describing the different instruments requisite for the treatment, I shall enumerate them in the following order:—

A. Apparatus for Congenital Talipes Varus in the Infant.

B. „ „ and non-Congenital Talipes Varus after four years of age.

C. Apparatus for Congenital Talipes Valgus in the Infant.

D. „ „ and non-Congenital Talipes Valgus after four years of age.

E. Apparatus for Talipes Calcaneus.

With each division I shall illustrate the instruments for treatment, and those for after treatment. The former are generally one or other of the many kinds of "shoes," which are not adapted for walking; especially in the appliances for the adult, mechanism is placed under the sole, and should any

undue pressure be placed here the rack-joint will be broken and the case retarded whilst the apparatus is repaired.

As equal an amount of importance belongs to the after treatment as to the primary reduction of the deformity. Undoubtedly cases would relapse if care were not exercised after the foot has been brought into the normal position, and it is only where this care has been neglected that relapsed cases are found. It is therefore essential that efficient walking instruments should be applied, instruments worn at night, and exercises performed. I shall, however, draw more particular attention to the appliances requisite for each condition as I proceed.

A. Apparatus for Congenital Talipes Varus in the Infant.

Of all the forms of Talipes this is the easiest to treat, as it is usually commenced and completed before the child begins to walk, the bones being supple, are readily altered in position, and the discomfort of the application of mechanism is not felt. The treatment is usually divided into two stages, the first for the cure of the varus, and the second for the cure of the equinus.

Splint for Cure of First Stage of Congenital Varus.

The flexible metal splint, Fig. 146, is always employed in the first stage. It is a straight, well padded piece of metal sufficiently firm to resist the strength of the infant, but malleable enough to be easily shaped. After the anterior and posterior tibial tendons have been divided, the splint is bent to the shape of the foot and leg, and should extend from the head of the fibula to the toes. The splint is now

Fi 146

bandaged to the limb, which should be performed in the following manner. Take three or four turns of the bandage first round the leg, then apply the splint and bandage along the entire upper part from the head of the splint to the outer malleolus. This forms the fulcrum, and enables the better extension of the foot to the lower part of the splint, which should then be completed, a gentle extension of the foot being made in an outward direction. After the third day it is removed, and slightly straightened and re-applied; this straightening is continued daily until the foot is brought into the same line as the leg, and the varus is cured. Fig. 147 indicates by the dotted lines the way in which this splint is gradually straightened. On viewing the lateral contour of the foot and leg it will be observed that the equinus, or second stage, has been reached. Subsequent on the division of the achilles tendon the previous splint is no longer useful, and the apparatus Fig. 148, Pl. 29 is requisite.

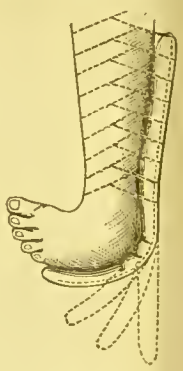


Fig. 147.

Mr. Adams' Varus Splint for second stage of Congenital Varus.

This illustrates the most efficient form of instrument yet devised for this stage, designed by Mr. Adams, and very largely used in practice. It consists of a calf and foot piece A B jointed at the heel by a single rack and pinion movement, hidden by the strap in the diagram but marked C. An extension to the thigh is made by a side stem with free joint at the knee, and attached to a thigh bandage D. This fixation above the knee is exceedingly useful in correcting any tendency to inversion of the leg below the knee due to lax ligaments at the knee joint. In applying

FIG. 150.

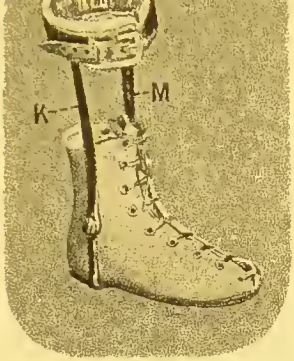
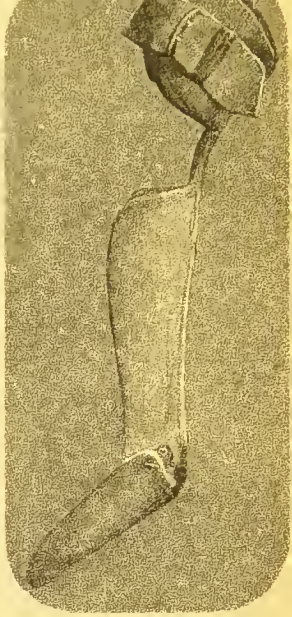


FIG. 154.



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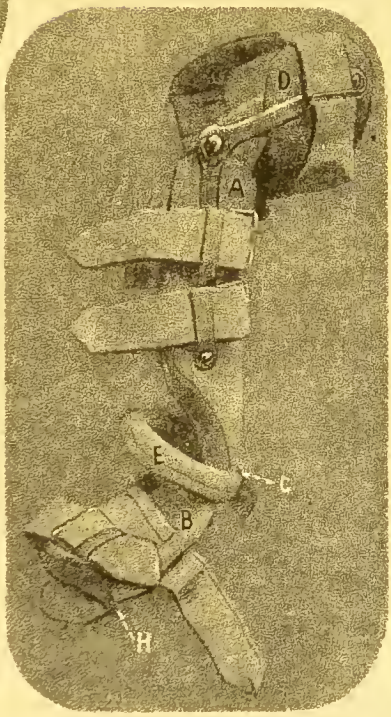


FIG. 148.

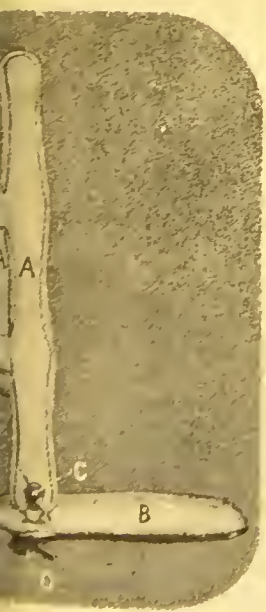


FIG. 152.

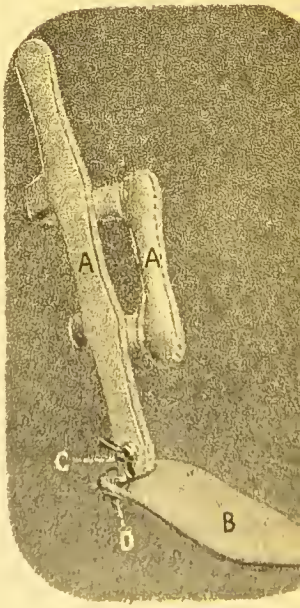


FIG. 153.

the apparatus the splint is adapted to the equinus position of the foot as represented in the illustration. The heel strap E is first applied, the calf and thigh bands being next secured, and the toe strap completes the attachment; this passes through the toe wire H under the sole of the foot, round the ball of the great toe and is then buckled, preventing any tendency to inversion, and keeping the foot in the same axis as the leg. The rack movement is then adjusted daily until firm union and elongation of the tendon has taken place, and the foot assumes the normal position. In slight cases of infantile talipes varus, the regulating thumb screw movement Tin Splint of Dr. Little, Fig. 149, may be used; it is chiefly suitable to hospital cases, on account of its small cost. It is fitted with a leg and foot piece, hinged at the heel, and regulated by a thumb screw at the side, and is adapted to the requisite angle of the deformity, (see the dotted lines *b. c.*,) and bandaged to the leg, care being taken that the heel is well in place, extension being made by the hand as often as requisite. I have lately improved upon this splint by the adaptation of a quadrant movement, which enables the more accurate adjustment of the angle than by the thumb screw holes, which cannot be made less than ¼-inch apart, and as the screw in the quadrant movement is fixed by a key, the splint is less likely to be altered in the absence of the surgeon. After the case has been cured by

Dr. Little's Tin Splint with Thumb Screw Movement.

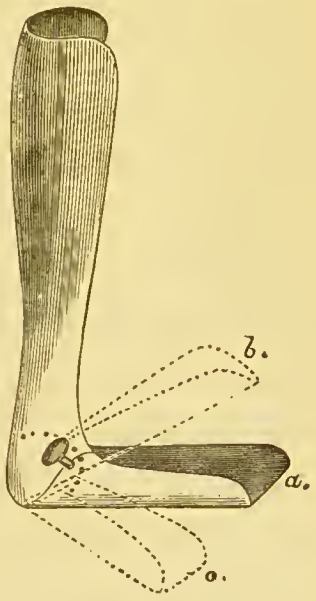


Fig. 149.

the use of either of the preceding apparatus, it is advisable to have a light retentive form of splint, fixed at a right angle for night wear, and a light boot for day wear.

Dr. Little's Right Angular Tin Splint.

Fig. 150, Pl. 29, represents the Tin Splint (right angular) of Dr. Little, which is so admirably suited for this stage; with the addition of a heel strap, the foot is kept entirely at a right angle and no tendency to retrogression takes place. The shoe is usually bandaged on to the foot, but can be fastened by straps and buckles. There may be sometimes an inclination for the heel to rise in the splint, particularly where children are restless, but by the supplement of a light thigh piece connected by a wire, this tendency is obviated, as the knee is kept slightly bent during the night. The illustration Fig. 151, Pl. 29, shews this addition.

Dr. Little's Adjustable Splint.

As an accessory to these splints, Fig. 152, Pl. 29, represents a very light adjustable splint (Dr. Little), often successfully used during treatment. It is composed of a light frame calf piece AA united to a sole piece B by two winged screws CC, respectively flexion and lateral movement, the action of which is shewn, Fig. 153, Pl. 29. This splint is usually secured by bandages.

Varus Spring Retentive Boot.

During the day the light boot and spring is always worn; the chief merit of this instrument, Fig. 154, Pl. 29, is the convex long spring K which is attached to the sole of the boot, and extended to the calf. The boot is first laced on, and the spring then brought in position. By the convexity and position of the spring the foot is forced to assume the condition of valgus, but if this be too marked, the power of the spring can be easily reduced by the controlling side strap M

which should be so fastened as to permit only a tendency to valgus to exist. One advantage in the use of this boot is, that the foot has perfect mobility, the spring having a free joint at the ankle, and with this attached the motion at the ankle joint can be gradually developed by manipulation. The preceding apparatus is most valuable before the child is capable of walking, the necessary subsequent apparatus I shall allude to in the next section.

B. Apparatus for Congenital and non-Congenital Talipes Varus, used in cases over Four Years of Age.

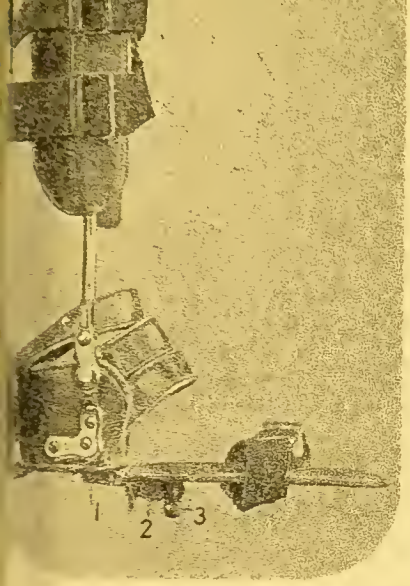
It is not every case of a congenital nature that is treated immediately after birth, and as the apparatus for the cure both of congenital and non-congenital talipes are the same, they are combined in this section.

Scarpas Shoe for Simple Equinus.

In simple cases of equinus, Fig. 155, Pl. 30, will be found the most effectual apparatus, and is the most improved form of Scarpas shoe that we possess. The object of the broad calf plate A is to prevent atrophy of the muscles from pressure, and the shoe B is made of metal side wings and sole plate, with the central portion of the heel of the shoe left quite free from steel, and merely covered by the leather and padding. This entirely obviates the possibility of a sore arising from over pressure on the os calcis. The calf plate and shoe are connected by a double rack movement C, this, with the exception of the difference in the design and workmanship, is the only remnant of Scarpa's original shoe. In the manner of fixing the instrument a great improvement has been made of late years, in the disposition of the straps.

Application of the Scarpas Shoe.

The method by which all my improved shoes are attached to the foot is as follows:—in the heel of the shoe three straps are fastened, 1, 2, 3, the centre of which, the "skate" strap, 2, is the most important. This is attached to the inside of the outer wing, passes over the foot, then between the foot and the shoe on the inner side, and finally through the hole cut at the back of the heel, and buckled, as shewn at 4. This hole serves two purposes; firstly, the passage of the "skate" strap, and secondly, to feel if the heel is in contact with the sole plate, and also during extension to gauge whether the sole plate is acting on the foot. The second strap 3 is the instep strap placed in front of the "skate" strap to act on the arch of the foot, it is usual to provide this strap with two buckles, one on the heel of shoe, as in illustration, and the other on the sole of the shoe 5; in the former position it serves to keep the heel down, and in the latter position acts on the arch of the foot, should this be abnormally high, produced by slight contraction of the plantar fascia; and the third strap, the ankle strap 1 which regulates the position of the foot when the lateral rack movement is used. I have entered somewhat into detail in the description of the construction of the shoe, but like the spinal apparatus, I want it to be clearly understood what constitutes the mechanical principle on which all shoes should be based. In addition to the straps already described, a toe wire D is placed to which a toe strap is attached, everting the position of the foot with relation to the leg. The preceding shoe is useful in cases of simple equinus only, but where the contraction exists in the sole of the foot, a more complicated apparatus is necessary. Mr. Adams has most conclusively



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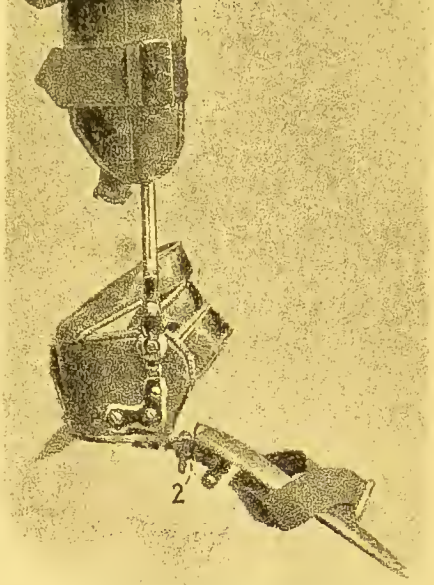


FIG. 161.

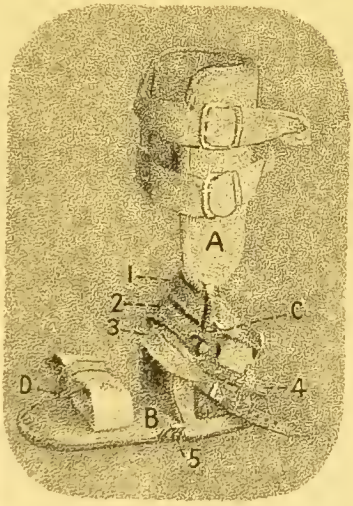


FIG. 155.

FIG. 163.

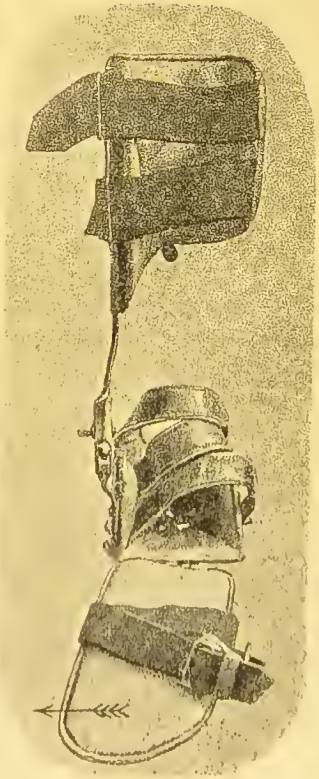


FIG. 162.

demonstrated the necessity of dividing the severer forms of talipes equino-varus into two stages, and treating the contraction of the sole of the foot as connected with the transverse tarsal joint, and the contraction of the achilles tendon as connected with the ankle joint.

Mr. Adams' Shoe with Divided Sole Plate.

This view led to the introduction of the shoe with the divided sole-plate, and undoubtedly the greatest advance in these apparatus was made when this was invented. Fig. 156, Pl. 30, illustrates this shoe. In appearance and mechanism at the ankle and disposition of the straps it is precisely similar to the preceding one, but the great advantage exists in the division of the sole-plate at a point corresponding to the transverse tarsal joint of the foot. This division is connected by a 3-action rack and pinion movement:—1 lateral; 2 uplifting; and 3 rotation. On examining any severe case, it is apparent that these movements correspond entirely to the position assumed by the foot in cases of extreme contraction, and it is manifest that such a shoe would undoubtedly be more efficient than that with a plain sole-plate. As an

Fig. 157.

Fig. 158.

illustration of the cases for which this is applicable, I have had drawings taken from casts in my possession of a case which was under treatment some time since. Figs. 157 and 158, represent the side and front view of the foot.

If the forepart of the foot, Fig. 157, could be extended it would be noticed that very little contraction existed at the ankle joint and that all the mischief rested in the sole of the foot; as a proof of this it might be mentioned that in this case the achilles tendon was not divided, but served as a point of counter-extension to keep the os calcis in position. Thus an important era in the treatment of Club Foot has been marked by the divided sole-plate, and as a still further proof of the sound practical results arising from this division, it is only necessary to point to Figs. 159 and 160 which are also taken from casts of the same foot after treatment.

Fig. 159.

Fig. 160.

Fig. 161, Pl. 30, illustrates the uplifting position by means of the centre rack movement 2, the front portion of the sole-plate being dropped to the extent of the contraction. Fig. 162, Pl. 30 illustrates the lateral movement indicated by the direction of the arrow, brought into play in connection with the preceding move-

ment, this alteration adapts the instrument to the inverted position. Fig. 163 Pl. 30 shews the rotation movement indicated by the direction of the arrow, combined with the preceding two movements, the outer border of the sole-plate is depressed and the inner raised to the position of the inverted and rotated foot. Generally, in these cases, contraction of the extensors of the toes also exists, and principally as a secondary result of the contraction in the arch of the foot, where these are divided, it is advisable to have slots cut in the sole-plate corresponding to the division of the toes, tapes can then be placed over the toes, and extension made by drawing the tapes firmly down, and securing them on the under side of the sole-plate. This shoe is always used after tenotomy, and is applied on the third day after the operation, gradual extension being then made by the mechanism.

Mr. Adams' Improved Shoe for Severe Cases.

In very severe forms of talipes-equino-varus I have made an alteration or rather supplement to the preceding shoe which consists in the addition of an extra uplifting movement. The object of this addition is to bring the sole-plate of the shoe in closer proximity to the sole of the foot at the point of division at the tarsal joint; by using the one uplifting movement only, it was found in very severe contractions that painful pressure was given to the ball of the great toe, but by the alteration in the plane of the front part of the shoe, pressure was obtained along the entire sole-plate, Fig. 164 Pl. 31 well illustrates the alteration of planes effected by this addition. Another improvement in shoes for equino-varus is that illustrated by Fig. 165 Pl. 31, and invented by Mr. F. R. Fisher. In addition to the

Mr. Fisher's Shoe for Severe Cases.

ankle movement and sole movement, an extension screw has been added, the object of which is to make a direct forward traction of the anterior portion of the foot.

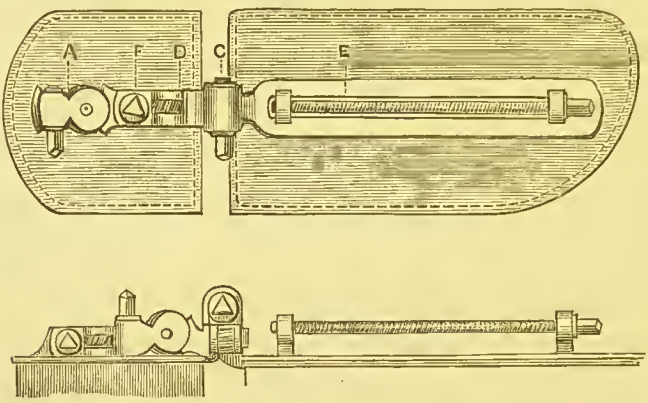


Fig. 166.

The details of this mechanism are illustrated, Fig. 166, the three movements are represented A D C the extension of the forepart of the foot being made by means of the elongating screw E. The most important apparatus for the treatment of equino-varus is that of Mr. Adams, for varus in the adult, and as this instrument is so little known and understood, I have asked him to let me describe its construction —repeating what he has so ably written in his work on "Club Foot," J. and A. Churchill, 1873—a permission he has very kindly given. He says, at Chap. XV., page 275: "In constructing it (the shoe), I determined, first—To subdivide the apparatus, so that only one portion of the foot should be acted upon at a time. Second—To place the mechanical centres of motion as nearly as possible opposite to the anatomical centres of motion in the foot, so that the anatomy should be represented in the mechanical apparatus.

Mr. Adams' Adult Varus Instrument.

Third—To transfer the fulcrum from the foot to the leg, thus combining all the advantages of the straight splint with the improved apparatus for the foot; and fourth—To carry the apparatus up to the thigh, and have a free joint at the knee, so as not only to steady the fulcrum effectually, and prevent the possibility of the instrument twisting round the leg, and following the foot, . . . but also to increase greatly the power of the instrument over the movements of the foot, without interfering with the freedom of motion at the knee joint." The necessity for this arrangement of the shoe, and the perfect knowledge of its inventor, can only be thoroughly appreciated by reference to the following diagram, Fig. 167, and the corresponding description taken from the same work, page 277.

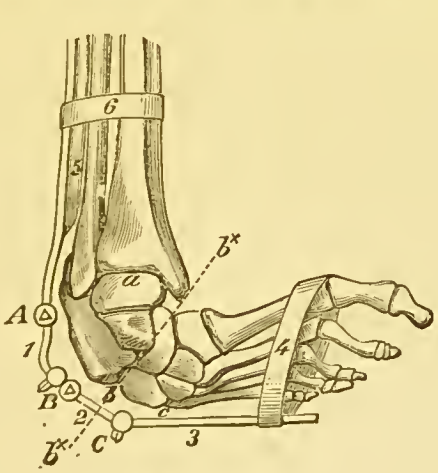


Fig. 167.

"The dotted line $b^* b^*$ intersects the great transverse tarsal joint, between the astragalus and os calcis and the navicular and cuboid bones, which in the club foot has an oblique direction, and indicates the line of separation between the anterior and posterior divisions of the foot, which move in different planes as above described. *A*, the first centre of motion, corresponding to

the ankle joint *a*. Flexion and extension only allowed at this joint. *B*, the second centre of motion, corresponding to the transverse tarsal joint *b* this is a double centre of motion; the first cog wheel moving in the direction of inversion and eversion, the second in the direction of flexion and extension, and especially useful in uplifting the outer border of the foot, and overcoming the rotation backwards of the cuboid and outer metatarsal bones. *C*, the third centre of motion, corresponding to the articulations between the tarsal and metatarsal bones *c*. Inversion and eversion only allowed at this joint, which is placed in this situation for the purpose of assisting the lateral cog wheel at *B* and to allow the instrument being more accurately adapted to the curved form of the foot, rather than from the existence of any amount of motion at the tarso metatarsal articulations. *1*, *2*, and *3*, indicate the levers moved by the cog wheels at the above described centres of motion. *4* indicates the situation and direction in which the force is exerted on the foot to produce eversion. *5* indicates the fulcrum on the outer side of the leg or point of resistance to the everting force employed against the foot from the cog wheels at band *C*. The pressure is diffused along the outer surface of the leg, between which and the side iron of the instrument a long soft pad is placed. The action is the same as that of the straight outside splint, but may here be combined with the uplifting force. *6* represents the band and trough by which the fulcrum is retained in its position."

One cannot read this minute description of the scheme of the apparatus without being struck with the masterly way in which the apparatus has been conceived. Although purely scientific,

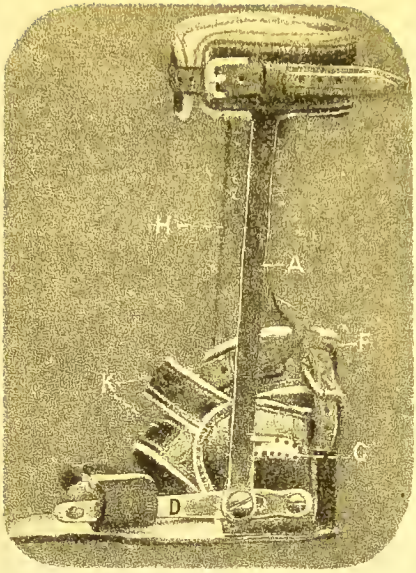


FIG. 168.

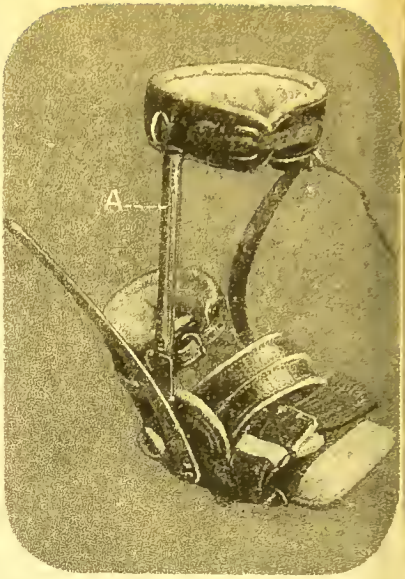


FIG. 169.

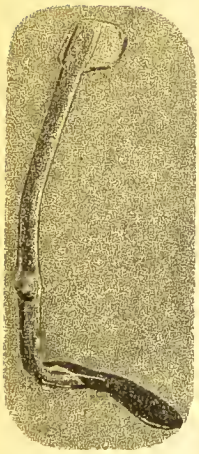


FIG. 173.

FIG. 164.

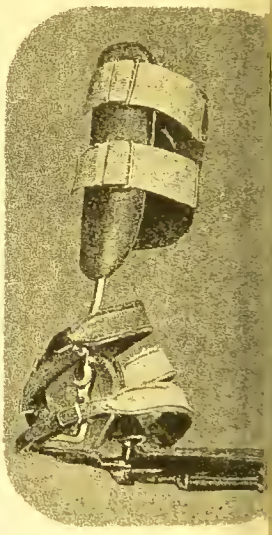


FIG. 165.

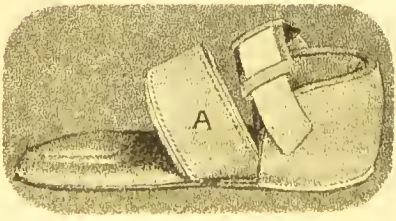


FIG. 172.

FIG. 174.

it is exceedingly simple, and it cannot fail to convince one as the successful result of deep thought. I have made several of these apparatus which in experienced hands have produced absolutely perfect results. With this appliance the list of shoes with rack movements is closed, but there are a number of shoes made on a different principle, viz., that of Dr. Little, which admit of mobility in an upward direction, and in certain cases the advantage of this plan is very great.

Dr. Little's Shoe for Varus.

Fig. 168, Pl. 31, illustrates Dr. Little's shoe with long spring and thumb-screw movement. The shoe itself is very similar to those of the preceding illustrations, but the mechanism centres in the long convex spring A extending on the outer side of the leg from the lower part of the shoe to the calf. The action of this spring is exactly the converse of the contraction. The extension or flexion of the foot is regulated by a thumb-screw movement C placed at the back of the spring on the heel of the shoe, and fitted to a series of holes, each slightly altering the angle of the spring. A toe spring D is also attached to the heel of the shoe which serves to evert the anterior portion of the foot. This shoe is fastened by two instep straps K and an ankle bandage F which is attached to the heel of the shoe by two back straps. These instep and ankle straps are first buckled and the toe strap affixed to the toe spring. The long spring is then brought into position at the same time everting the entire foot. This eversion can be regulated by the inner controlling strap H which springs from the heel, and is fastened to the calf plate, by this means the long spring is entirely under the control of the surgeon, and the exact amount of force can readily be adjusted.

Dr. Little's Double Hinged Lever Shoe.

In severer forms of varus, Dr. Little's double hinged lever shoe, Fig. 169, Pl. 31, is often used. By the addition of this lever A the calf plate can be at once brought into position, and the extension on the achilles tendon continued, whilst the long spring for the reduction of the varus can be more gradually applied by fastening the top or slotted end by a tape to the calf plate, and gradually drawing the spring into position.

Dr. Little's Long Spring Shoe with Rack adjustment.

Another very convenient form of Dr. Little's shoe is that illustrated, Fig. 170, the long spring shoe with rack adjustment. By placing the rack movement *d* behind the spring, the entire length and power of the spring is maintained with an easy method of alteration, the con-

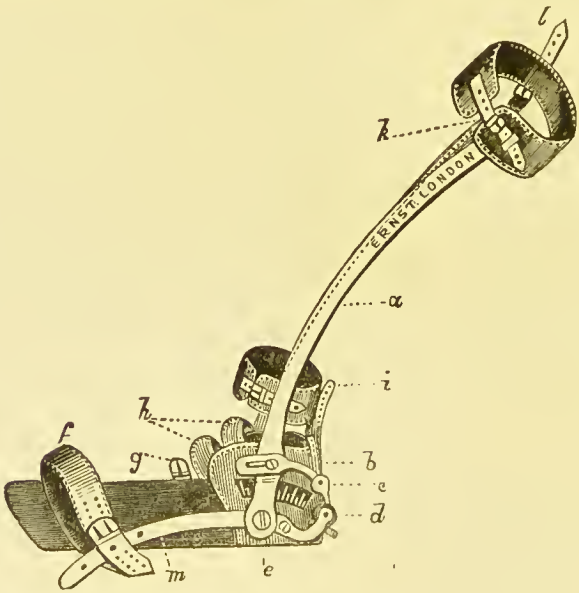


Fig. 170.

necting lever *e* is slotted to permit of slight mobility upwards. This method is very desirable in cases where there is any fear

of the mechanism being altered after it has been adjusted, and in the absence of the surgeon.

As a means of ascertaining the exact position of the extension force, a graduated indicator is affixed to the heel-piece. As a still further improvement in these instruments, Fig. 171 shews the long spring shoe with the spring articulated in apposition to the ankle joint, the thumb-screw acting on a tailed piece connected to the spring. This is suitable for adult cases.

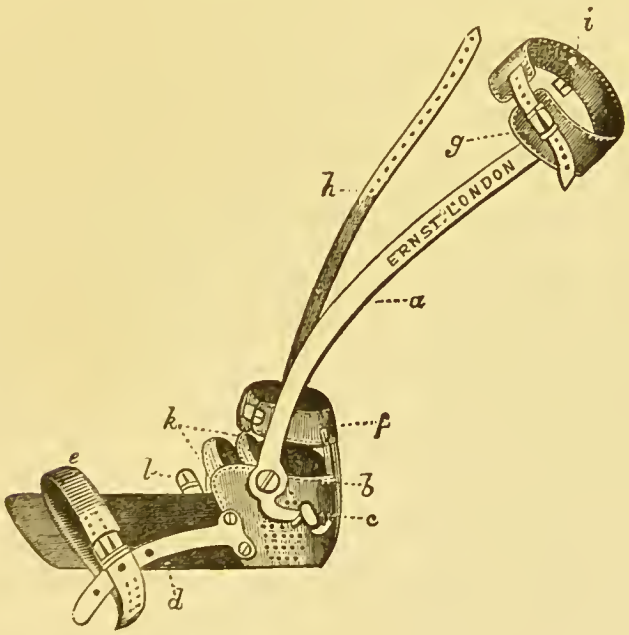


Fig. 171.

Scarpas Shoe Sole Plate for Talipes Arcuatus or Pes-Cavus.

The foregoing represent the best active apparatus for treatment of youthful and adult cases, the retentive appliances have been illustrated by the tin splints, but there is, in addition, the Scarpas shoe sole plate, Fig. 172, Pl. 31, which can also be used as a retentive splint, it is, however, generally applied for treatment of talipes arcuatus or pes-cavus,

and is provided with a broad leather instep strap A buckling to the inner side of the sole plate. I have now enumerated the various apparatus used for the treatment of club foot together with the retentive appliances. The walking apparatus are the next most important factors. The simplest instrument is the concealed spring of Dr. Little, which is applicable to cured cases of a very slight nature, or to cases with a tendency to varus without mechanical treatment, or is often used even in severe cases after long treatment for evening wear.

Dr. Little's Concealed Spring.

Fig. 173, Pl. 31, illustrates this spring alone. In cases of varus it is inserted between the leather and lining on the *inner* side of the boot, being concave, the foot is laced up to the spring when the boot is fastened. There is a joint below the ankle to admit of free movement in walking. It is advisable to note in making the boots for this spring, that they should not meet by at least $\frac{3}{4}$ of an inch, otherwise, when the leather stretches from ordinary wear, there will be no means of continuing the support to the ankle. This spring is shewn inserted in the boot, Fig. 174, Pl. 31.

Dr. Little's No. 1 Walking Instrument.

Dr. Little's No. 1 walking instrument, Fig. 175, Pl. 32, is on the same principle as the long spring used in the night shoes (Little's), applied to walking purposes; in slight cases it is exceedingly useful, and possesses a degree of elasticity which is extremely comfortable in wear. Of the rigid apparatus, one of the best forms is the firm upright, with regulating stop joint, Fig. 176, Pl. 32. The instrument is applicable to those cases where the foot has not been quite brought to the proper angle by extension treatment, all chance of re-contraction is

Dr. Little's Firm Upright Walking Instrument, with Regulating Stop Joint.

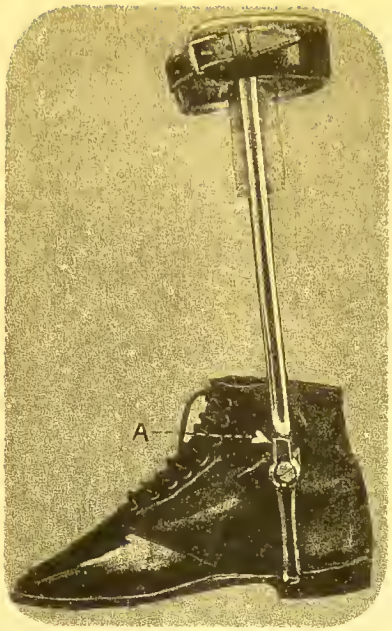


FIG. 176.

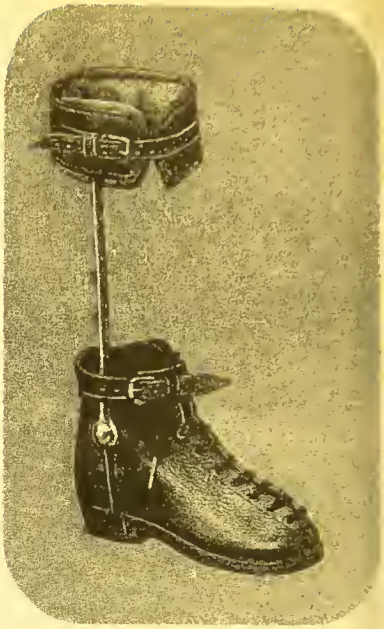


FIG. 177.

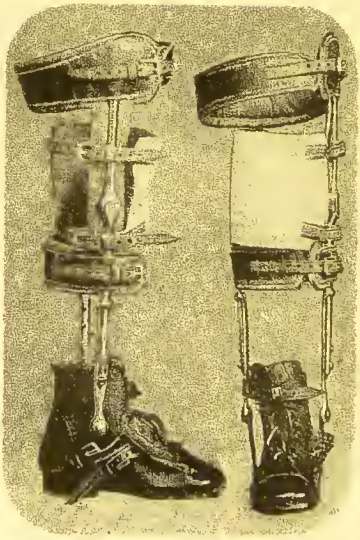


FIG. 179.

FIG. 178.

FIG. 175.

avoided, but free movement in an upward direction is permitted. The mechanism consists of a screw A passing obliquely through the double joint, and binding on a lip of the single joint. This screw can be gradually altered to increase the angle at which the foot is "stopped."

Firm Upright Apparatus.

Fig. 177, Pl. 32, depicts the simple firm upright walking apparatus with free joint at the ankle. In cases of varus it is attached to the boot on the inner side of the leg, extending to the calf, with a calf plate. The support to the ankle is derived from a varus T strap, which is sewn on the outer side of the boot, and buckled *round* the steel upright. Although apparently all that is necessary, the apparatus ceases to be satisfactory after the first few weeks use. Owing to the small surface of the joint which soon begins to wear, the shoe piece and upper portion of the instrument do not keep in the same axis, and as soon as this commences, by the unequal weight on the joint, it is quickly increased and the instrument inclines to the position of the foot, thereby failing to give the necessary support. I have so frequently experienced this, that I always urge the necessity of the "Double Upright Instrument." By the addition of this other upright, Fig. 178, Pl. 32, the foot is most perfectly controlled, the weight very slightly increased, and a durable apparatus supplied. The uprights are made detachable by the simple keyhole catch movement described in the first chapter, and the support is derived from the varus T strap. It is a very important matter that the shoe piece should be "set on" the instrument to evert the foot. In many cases it is also advisable to place a "stop" in the ankle joint which shall prevent the foot from flexing beyond

Double Upright Walking Instrument.

18 over the right angle, especially in cases of weak union of tendon this is most desirable, as any severe flexion of the foot or undue strain might lead to ruptured tendon with its serious consequences. In addition to the varus T strap, it is sometimes necessary to add an internal transverse toe strap if there is much tendency to inversion, this is attached to the anterior border of the boot, passing under the sole of the foot, over the instep, and through a slot cut in the upper leather, and fastening to a buckle attached to the shoe piece. It is not always possible entirely to control any tendency to inversion by this means alone, as in many cases the inversion is due to rotation of the tibia, occasioned by lax ligaments at the knee-joint. According to the severity of this rotation, it is better to use one or other of the following apparatus.

Walking Instruments to Thigh and Pelvis to control inversion of Feet.

Fig. 179, Pl. 32, gives a front and side view of the light walking apparatus extended to the thigh, with a "free" joint at the knee. This is often used as the first walking apparatus for children, who, although they possess the power to evert the feet, are not old enough to understand what is required to keep the feet "turned out" in walking. Fig. 180, Pl. 33, shews the long instrument always used where any considerable inversion exists; by taking the point of fulcrum from the pelvis, the inward rotation is corrected from the hip joint, and with this apparatus in use it is absolutely impossible for any "turning in" to take place although perfect mobility is allowed. With the double instrument (*i.e.* for both legs) the hip joint has an auxiliary in the form of a "lateral" movement, permitting full abduction of the legs. This joint is also useful on another score, and

that of prevention of breakages, which will sometimes occur from undue lateral strain. The two preceding appliances are supplied with soft leather knee-caps, which are fastened in such a way as to exert a counter rotary action when buckled, and the apparatus are also made to lengthen correspondingly with the child's growth.

Dr. Doyle's Spiral Spring Rotator.

In slight cases of equino-varus, for after treatment, the Rotator of Dr. Doyle has been found to answer very well indeed. It is an exceedingly ingenious instrument, and Fig. 181 gives a general view of its constitution. It is constructed with two spiral springs A A which are attached to the pelvic band B at D and to one of the boots at E these latter are detachable. The mode of application of the instrument is as follows: the pelvic band B is first secured to the pelvis and the boots put on; one leg of the rotator is taken in the hand, and rotated inwards two or three times, the lower part is then slipped into the socket of the boots, and the thigh and calf plates C C fastened to the limbs. As a matter of course, the tendency of the spring is to untwist itself, and consequently a greater or lesser degree of eversion is given to the foot, according to the number of times the spring has been rotated. This instrument is shewn applied at Fig. 182. It can also be very beneficially used where any tendency to walk "pigeon-toed" exists without deformity.

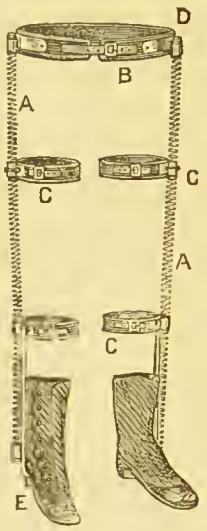


Fig. 181.

Before I leave the description of "varus" instruments I will explain the foot exercising apparatus. It is well known

that after the treatment of Club foot only a partial amou of movement remains in the ankle joint. This can increased by daily exercise, shampooing, massage, and by manipulations from an experienced rubber. This latter, however, cannot always be obtained, and to supply this want and enable the exercise to be continued at home, I have devised the foot exercising apparatus, illustrated Fig. 183, Pl. 33, and shewn in use Fig. 184, Pl. 33.

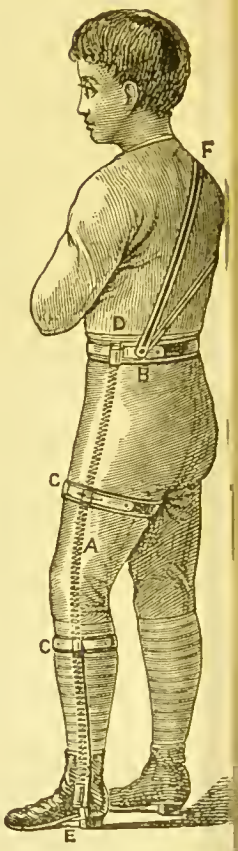
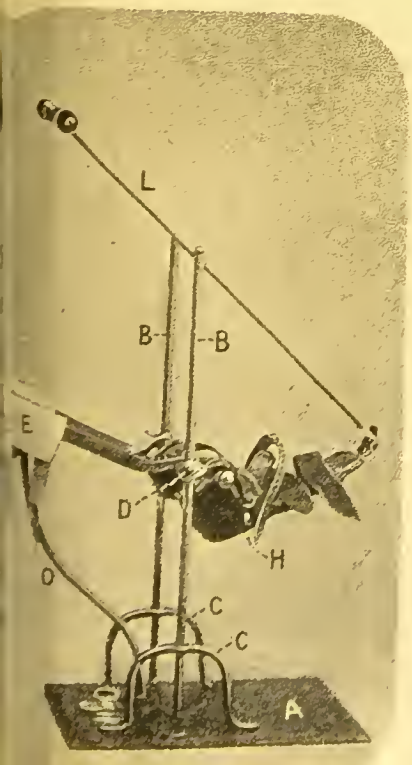


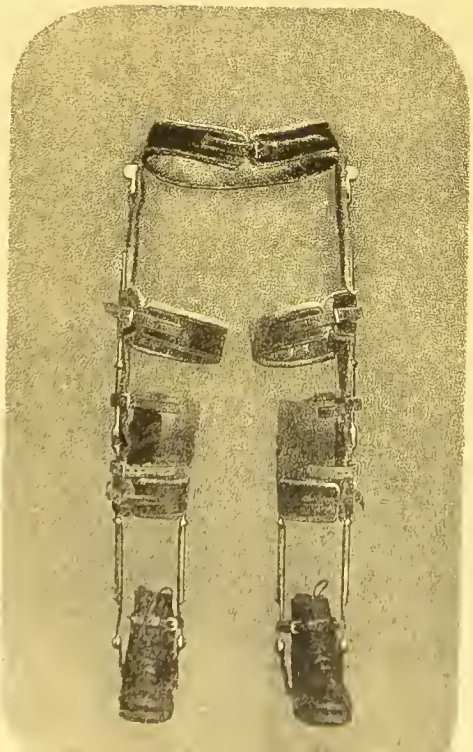
Fig. 182.

Foot exercising Apparatus.

It is most important that the flexion exercise of the foot should be carried out as perfectly as possible, and that the foot and leg should be kept in a straight line during exercise. Now this is a most difficult matter for even an experienced rubber to achieve, and I venture to say that my machine is of the two the more reliable; moreover, when patients have reached the age of seven, they may by this means very material assist in curing themselves. To obtain this result it essential that the exercise be practised with regularity least three times a day. The apparatus is composed of a fl board A attached to which are two parallel irons B B strengthen by curved bridges C C. The exercising arrangement is attach to these parallel irons by two brass balls provided with thum screws D; these are to regulate the position according to t

FIG. 184.





height of the chair. To these brass balls the leg trough E and shoe H are attached, the latter having a "free" joint at the ankle; and a long exercising lever L at the end of the shoe, terminating at its upper end in a strong cross handle. The leg trough is supported by a regulating back iron O. In adjusting the shoe, it should be noticed that the greatest good is obtained by having the knee flexed at an angle of 45°. In this way the tendo-achilles is elongated, and the fullest range of motion acquired at the ankle joint. The foot being buckled firmly in the shoe, the patient grasps the cross handles, and exercises the foot by a short jerky movement upwards and downwards. By the length of the lever, either a greater or lesser pressure can be exerted, and without much expenditure of physical force, whilst from the mechanical construction of the ankle joint of the shoe it is impossible to work the foot in a wrong direction. In relapsed cases this exercising apparatus is invaluable, as it is only by *systematic stretching* that the adhesions can be broken down, and in cases of Pott's fracture after union, or stiff joint in partial anchylosis, this instrument may be most safely employed. I have several times divided the sole-plate after the same principle as "Adams' shoe," so that the arch of the foot can be worked independently of any movement at the ankle joint, and *vice-versâ*, this object being obtained by a double ring catch joint situated at the ankle, and in the sole of the foot.

C. Apparatus for Congenital Talipes Valgus in the Infant.

The cases of congenital talipes valgus in the infant are comparatively speaking rare, and presenting exactly the

opposite deformity of talipes equino-varus, the mechanis requisite is not of such an elaborate nature. The majorit of cases are amenable to mechanical treatment, and in th simpler forms it will only be found necessary to use Dr. Little tin splint, fitted with an inner flange, and a valgus pa attached to the sole plate. This splint is either bandaged to t foot, or fastened by a series of straps and buckles. It is usuall worn until the child is able to walk, and then some support applied which will be described later on. The tin splint keepin the foot perfectly at rest, often interferes with the mobility a the ankle joint; to obviate this, Mr. Adams has devise a splint, Fig. 185, Pl. 34, which consists of a sid trough A fastened to the leg by straps and buckles at the lower end, a convex toe spring is attached, with a move able valgus pad B. In applying the splint, the leg trough is firs fixed, and the foot is gradually inverted to the spring, the "pad corresponding with the arch of the foot. This splint possesse the advantage of economy, inasmuch as the valgus pad bein made to slide on the spring, it can readily be altered to th growth of the foot. These splints suffice for the mechanica treatment of congenital valgus, but where operation is neces sary, it is requisite to resort to the rack movement as a mean of making gradual extension. In a case recently under treat ment of a very severe nature, the peroneii tendons wer divided, and after three days one of Adams' converted varu splints was applied and altered periodically; this splint ha been constructed somewhat differently, the mechanism consistin of two movements at the heel, viz., a lateral and flexion move ment, and the sole plate being fitted with a valgus pad; by these

Mr. Adams' Valgus Splint.

ıovements the foot was inverted, and the arch very effectually eformed. I have not figured this instrument, as, with the xception of the extra mechanism, it has already been described mong the *varus* instruments. The walking apparatus for these ases is exceedingly simple, and is of the light long spring order escribed for varus. In cases of valgus the spring is placed on ıe inner side of the foot, and a small vulcanised rubber pad orresponding to the arch of the foot inserted in the boot. hese apparatus are all that are requisite for this class of cases.

). Apparatus for Congenital and non-Congenital Talipes Valgus after Four Years of age, and in the Adult.

The essentialities for these cases may be divided into three eads, and correspond to the three classes generally known as—

1. Slight or spurious flat foot (commonly termed "weak ankles").
2. Flat foot without tendon contraction.
3. Flat foot with tendon contraction.

Valgus Walking Boot.

In the first class, a boot with a valgus pad is sufficient. This boot ought to be made with firm stiffening under the arch of the foot, and with the heel tended along the inner border beneath the waist of the boot echnically called an "oblique heel") to give extra support to the lgus pad. I have always used the vulcanised rubber pad, in eference to the metal arched sole, for the reason that the d is light, is fastened to the boot and cannot therefore be splaced, is cheaper than the metal sole, and the pressure is not severe. Where great weakness exists it is often advisable to e this pad in conjunction with the concealed spring.

Concealed Spring Boot for Valgus.

This is similar to that described for varus, the spring being curved convexly, and placed with the concavity on the outer side of the foot. In lacing the boot the spring materially assists the effect of the pad, besides giving great support to the ankle. In the second class of cases there exists considerable flattening of the arch of the foot, and here it is advisable to have more rigid support, and also to combine the use of mechanism at night.

Night Shoe for Valgus.

A light valgus shoe, which has lately been very largely used, may be applied with great advantage, and is similar to Fig. 186, Pl. 34. It is arranged with a metal sole plate and a valgus pad attached, this is fastened to the foot by a series of straps and buckles, similar to the ordinary Adams' shoe. On the inner side of the shoe a long spring with a free joint at the ankle is placed. In applying this shoe the heel straps are first fastened, and after the foot has been adjusted to the pad, the long spring is brought into position. This spring is usually made stronger than requisite, as the object is rather to invert the foot, and thereby reform the arch, but should the inversion be excessive, it is regulated by the outer long controlling strap. In conjunction with this night apparatus, it is essential to use some form of day instrument, and although the firm upright walking apparatus is often used, I decidedly prefer the double upright for the reasons already stated. The boots for valgus attached to these instruments are made as described for weak ankles, and have the pad placed under the arch of the foot. To render an efficient and firm support, a valgus T strap is sewn to the inner border of the boot, and fastened round the outer upright of the instrument. These instruments

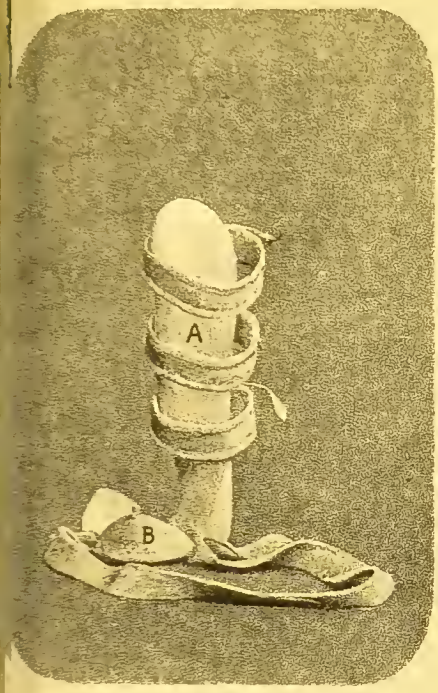


FIG. 185.

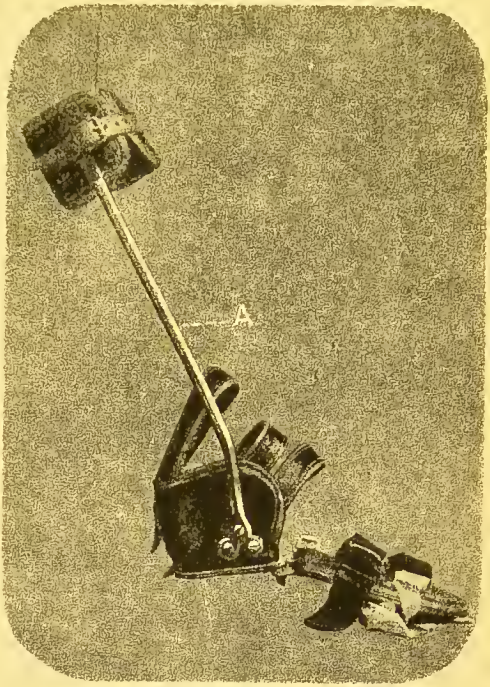


FIG. 188.

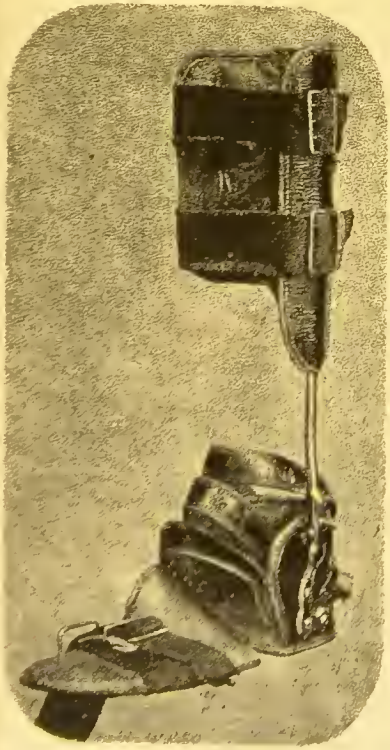


FIG. 187.

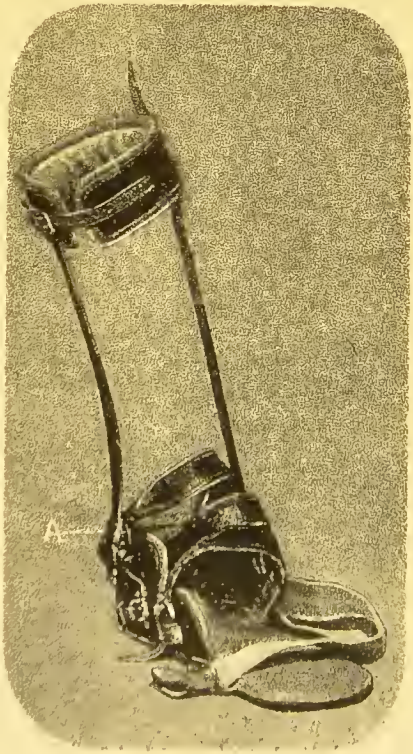


FIG. 186.

are like those for varus and need no further explanation. In the third class of cases there is need for tenotomy, as the contraction is generally of long standing, and does not yield so mechanical extension. There are two kinds of contraction, that of simple tendo-achilles, and the more severe form of tendo-achilles accompanied with that of the peroneii tendons.

Night Shoe for Valgus with Rack Movement.

In the former class the shoe, Fig. 186, Pl. 34, has been found very serviceable, it is Adams' long spring shoe, with a rack movement A at the ankle. This flexion movement regulates the rate of union of the achilles tendon, and the long spring acts on the pad as previously described. In the severer forms of contraction, the more complicated shoe, Fig. 187, Pl. 34, is employed; ankle racks are placed on the outer side of the foot, and the "3 actions" in the sole-plate correspond entirely with the Scarpas shoe explained in the varus section. After cure by either of these instruments, the double upright walking apparatus is used; and it would be well to observe that as the foot increases in strength, this support may be diminished, and the plain valgus boot substituted. It is very seldom that an apparatus (walking) for valgus is carried above the knee, and I have only done this in one instance, where the lax ligaments at the knee joint caused the leg and foot to rotate outwards thereby increasing the deformity.

Mr. Adams' Adult Valgus Shoe.

E. Apparatus for Talipes Calcaneus.

This troublesome deformity often exists in conjunction with the preceding forms of valgus, and in this state is usually

congenital. It can be treated in the earliest stages with the tin shoe with thumb-screw, or by a tin splint fixed at an obtuse angle. These splints are already so well described as to need no further mention.

Shoe for Calcaneus.

In more advanced cases, it is best to use the shoe represented, Fig. 188, Pl. 34. This is a metal shoe with a single uplifting rack movement corresponding to the transverse tarsal joint. Commonly in these cases the tendo-achilles by over elongation permits the dropping of the os calcis, and as a natural result the plantar fascia becomes contracted; by this shoe and the obtuse position of the upright A: the heel is raised in a position to favor recontraction of the tendon, and the fore part of the shoe is assimilated to the contracted state of the arch of the foot, gradual upward extension being then made, after division of the plantar fascia. I have recently much improved this shoe by adding a second rack movement, and placing the mechanism in the same line of axis as the foot. By this means it is evident that the movements correspond to the transverse tarsal and ankle joints. The heel is elevated by a cupped buckskin heel piece, and the two movements are worked simultaneously, producing a gradual unfolding of the foot. The fulcrum is the trough piece, which is firmly attached to the leg. This instrument is suited both for mechanical and operative treatment. For walking purposes in slight cases, the single or double instrument may be sufficient, but it is advisable to have the ankle joints fitted with a three quarter stop, *i.e.*, the joint stopped a little over the right angle to avoid the heel dropping, and a transverse instep strap is of great assistance. The most effectual apparatus,

however, is the firm upright walking instrument, with toe depressing spring, this has the contrary effect of the toe elevating, and keeps the foot continually flat on the ground at the same time stretching the anterior muscles of the leg, and favoring the recontraction of the tendo-achilles. This instrument is illustrated in the chapter devoted to paralysis of the lower extremities.

CHAPTER IX.

APPARATUS FOR PARALYSIS OF THE LOWER EXTREMITIES.

General Remarks on the Application of Mechanism.

The application of mechanism to cases of partial or complete paralysis of the lower extremities has often been negatived on the ground that "Instruments only tend to weaken and do not restore power to the limb." So far as the first part of this statement is concerned, it is not borne out in my observations; and with regard to the latter portion, although muscular power is certainly not given to the muscles themselves, yet their action and use is replaced and great assistance afforded. This remark applies in a very decided manner to those cases of partial paralysis, where it has frequently been my experience to see patients, who have hitherto walked by the aid of crutches and sticks, dispense with these when supplied with suitable apparatus. I am speaking of those cases where a judicious use of mechanism is made, and not the indiscriminate application of a general support. It is very unusual to see a case where entire paralysis of the lower extremities exists, either one or the other set of muscles has life, and it is to supply those other lifeless antagonists with help that mechanism is devised. It is on the same principle that galvanism, which, formerly was employed generally, is now only used locally where science has shown the necessity. With

regard to these cases, there has been one great point much overlooked in the condemnation of appliances, and that is their incalculable use in the prevention of deformity. I constantly see cases of a paralytic nature, where it is impossible to bring the foot into its normal condition, owing to a contraction of some tendon. This contraction has been increasing gradually, owing to the want of opposing force, and the result is a serious deformity, causing the patient to be either greatly crippled or entirely disabled from using the limb. Mechanism in the early contractile stages can prevent this; when the tendency towards it is first noticed, a light splint worn at night will keep the foot in its normal position, and a light steel walking apparatus enables the patient to tread on the sole of the foot during the day. When the contraction has assumed a very marked condition, it is useless to apply "walking steels," although the limb may be kept in a good position at first, the boot will gradually give way and the foot revert to its abnormal state, with consequent undue pressure of the steel, and possible wounds. It is therefore imperative in the application of "walking steels" to paralytic cases, that all marked deformity should be previously remedied, and this is best done by tenotomy and mechanical extension treatment. There are, however, a number of cases with slight tendon contraction, (and I allude principally to those of contraction of the achilles tendon) where the foot cannot be flexed beyond the right angle, and here it will be found perfectly safe to use a walking instrument in the day, and a slight extension instrument at night. Not only is mechanism useful in the prevention of deformity, but the assistance given is very decided.

Use of Mechanism as a preventive of Deformity.

Take a case of partial paralysis of the extensor tendons of the foot; by an effort of the patient the toes are brought into action and the foot slightly drawn up, there may be no corresponding contraction, but the patient finds serious inconvenience from this loss of power, the foot catches at all raised obstacles, and the toes are constantly dragged along the ground, to take a step the whole leg must be raised and the foot brought like a flail on the pavement. What can be done to remedy this? I can unhesitatingly say everything. I can give this case an instrument which shall enable the patient to walk with a natural gait: this in itself no slight achievement. But there is more than this, by the constant action of the apparatus there is full flexion of the foot, and any tendency for return of natural power to the extensor tendons is increased by this movement. In other words, a case like this without mechanism is helpless.

Assistance given by Mechanism.

In classifying the cases in which apparatus for paralytic affections of the lower extremities are applicable, I shall divide the description under three heads.

1. Appliances for loss of power of the anterior muscles of the leg involving the several forms of varus, valgus, or calcaneus.
2. Appliances for loss of power above the knee combined with No. 1 class.
3. Appliances for loss of power from the pelvis downwards.

A set of cases very frequently seen are brought together under my first heading, and are a series in which very great mechanical assistance can be given. Constantly, in advanced life, one meets with cases of loss of power of the anterior muscles of the leg,

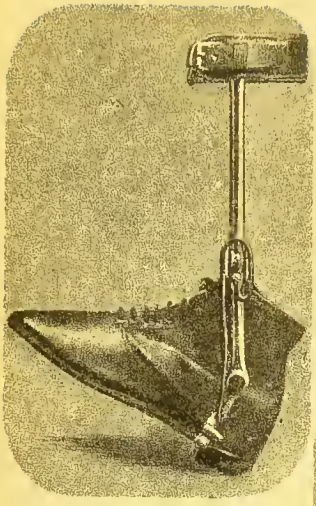


FIG. 189.

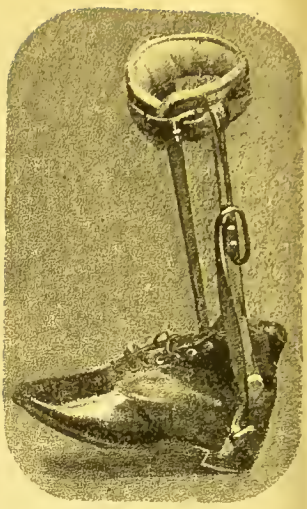


FIG. 191.

FIG. 192.

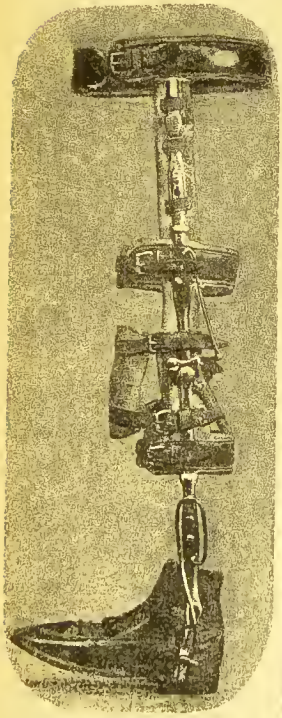


FIG. 194.

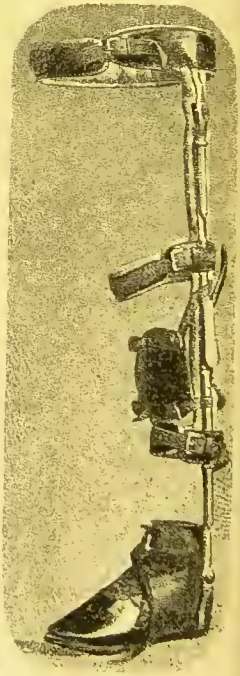


FIG. 193.

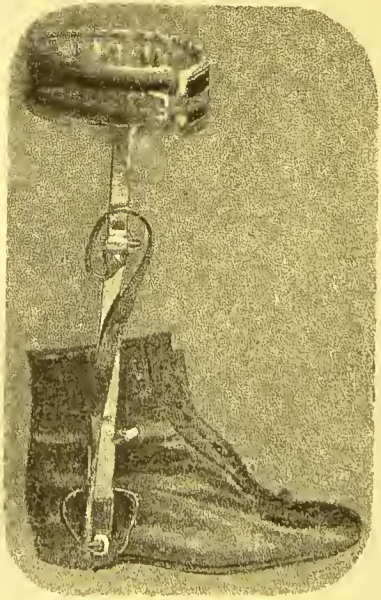


FIG. 190.

such as I have just described, and with the corresponding difficulties in walking. These cases have no tendency either to valgus or varus, and, if neglected, often produce simple equinus, a result of contracted achilles tendon. It is evident that some form of apparatus is necessary here to elevate the toes in walking, yet permit the foot to be brought quite flat in standing. The most perfect kind for this purpose is represented at Fig. 189, Pl. 35.

Toe Elevating Spring Apparatus.

It consists of a light firm upright, which is attached to the boot and carried to the calf and fastened by a calf bandage, there is a free joint at the ankle, but the principal mechanism is centred in the toe elevating spring which is attached to the upper part of the instrument and extended to the shoe piece where it acts on a small roller, which minimises the friction in the uplifting force. The action of the spring is automatic; when the patient places the foot on the ground the weight of the body overcomes the spring power, and the sole and heel are at the same time taking an equal bearing, as soon as the weight is released the spring immediately elevates the toes, and the patient is enabled to take the next step without any difficulty. The illustration shews the mechanism adapted to a single upright only, but I very frequently attach the spring to the double upright instrument. In connection with this spring power there is one point which for some time considerably perplexed me, and that was the exact strength of spring with which to commence, and in several cases I had to construct three or four springs before the correct power was obtained. I therefore worked out the regulating elevating spring, which has been of so much use. This is indicated, Fig. 190, Pl. 35. It

Regulating Toe Elevating Spring Instrument.

will be noticed that this alteration of strength has been obtaine by affixing the toe elevating spring to the upright by a small rac and pinion movement, which, by altering the position of th spring, correspondingly alters its power. The advantage c this is obvious. Not only can the patient apply the instrumen with the greatest accuracy, but it places in the hands of th Surgeon an elastic regulating extension force, that can b increased or moderated at will. More especially in cases o spastic contraction this spring has been found invaluable, her the contraction often presents the features of rigidity, but th tendons gradually yield to gentle continuous pressure and th foot assumes the normal position. In cases of paralytic varus i is essential to remove the deformity before the application o walking apparatus. This remark also applies to paralytic valgus, and in both cases the contraction may be remedied by tenotomy and application of one or other of the extension shoes. For the walking apparatus the preceding spring instrument is suitable, but is best applied in the double upright form, for varus it is usual to add a "varus" T strap, which is fastened to the outer side of the boot and buckled over the inner upright of the steel, and for valgus a "valgus" T strap and pad. In delicate children, or cases of a slight nature, a single steel instrument is all that is necessary, and this is best arranged as shewn in Fig. 191, Pl. 35. The instrument comprises the adaptation of the "elevating" spring to the "long" spring of Dr. Little, by the combination of these two spring forces eversion and elevation are secured. It is often necessary to attach a pressure pad on the long spring to act as a point of fulcrum for correcting the inversion. This instrument for

Walking Instrument for Paralytic Varus or Valgus.

varus is applied on the outer side of the leg, and for valgus on the inner. In all these apparatus it is advisable to have a three-quarter stop fitted to the ankle joint, *i.e.*: a stop which shall hinder the foot from rising beyond 20° above the right angle, the object of this is to prevent the foot running into a condition of calcaneus, resulting from weak achilles tendon or over-powerful elevating spring.

In all cases of a paralytic nature there will generally be found some shortening of the limb, and it is advisable carefully to measure both legs, so that the deficiency may be made up in the shape of a cork sole to the boot. In cases of simple calcaneus, either of the foregoing instruments will be sufficient, but it is of course necessary to convert the toe "elevating" into a toe "depressing" spring, Fig. 192, Pl. 35, as in these cases the toes are already too much off the ground, it is necessary to depress them accordingly. I am enabled, by the kindness of a patient, to illustrate a typical case of calcaneo-valgus, with the necessary apparatus for night and day. In Fig. 195, Pl. 36, the condition of the limb is shewn, there was considerable contraction of the tibialis anticus and plantar fascia, together with slight loss of power of the rectus. The limb was three inches shorter than the left, and the youth had considerable difficulty in walking without the help of a stick or crutch. The first apparatus used was a night shoe, to remedy as far as possible the contractions already mentioned. This, Fig. 196, Pl. 36, consisted of a light metal sole plate with an upright attached at an obtuse angle, which position best favored recontraction of the achilles tendon, and extension

Walking Instrument for Calcaneus.

Apparatus for Calcaneo-Valgus.

of the tibialis anticus, the contraction of the plantar fascia was remedied by the broad instep strap A, attached to the outer side of the shoe, and buckled to the inner margin of the sole plate. Fig. 197, Pl. 36, represents this shoe applied. The walking apparatus, Fig. 198, Pl. 36, was extended to the thigh, with a free joint at the knee and a single knee cap, from the calf the instrument was carried on either side of the leg to the ground, with a toe depressing spring A on the outer side. This spring, I should mention, is constructed after a new pattern which I have only lately invented, and which in many instances is more convenient than that previously mentioned. The valgus condition was remedied by the valgus T strap B, and assisted by the above ankle strap D, whilst the contraction of the arch of the foot was arranged for by the instep strap C. The instrument was made detachable by vertical side sockets E, which permitted the use of a second boot. In Fig. 199, Pl. 36, the apparatus is shewn effectively applied.

In the second class of cases we find a loss of power above the knee, which prevents the patient from bearing any weight on the joint, owing to the sudden collapse which ensues should the slightest flexion of the limb take place; or should this collapse not exist, there will probably be a tendency to backward bending of the joint, causing undue strain on the ligaments. The simplest instrument to give security in walking is the walking apparatus extended to the thigh, with "ring catch joint" at the knee. This has already been so thoroughly explained, that no further allusion to it is here necessary. A very ingenious instrument for similar cases is that illustrated, Fig. 193, Pl. 35, the

Flute Key Catch Apparatus for Knee.

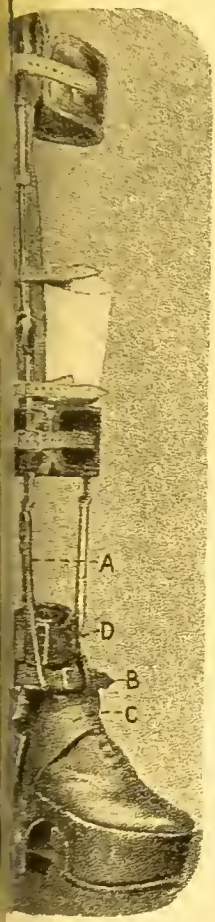


FIG. 198.

FIG. 195.

FIG. 199.

FIG 197.

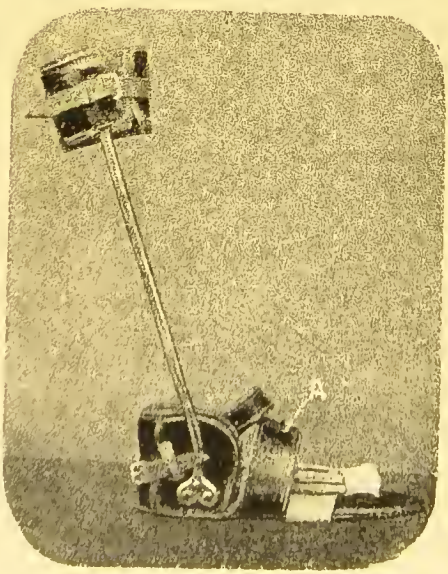


FIG. 196.

flute key catch apparatus. The particulars of this mechanism have already been fully described in Chapter I., Fig. 14. It has this advantage over the ring catch, viz., that the spring fastens itself as the patient extends the limb. However, both of these apparatus favour immobility of the joint, and in many cases it is desirable to have mobility with support. The instrument, Fig. 194, Pl. 35, shews the "gun lock spring" instrument. This spring power, similarly to the toe elevating, is automatic, the strength of the biceps and hamstrings is sufficient to flex the joint (*see* Fig. 23, Chapter I.), and immediately this power is relaxed the spring extends the lower leg, and the patient is enabled to take a step without swinging the limb. Not only in cases of partial paralysis, but in cases of locomotor ataxy, has this instrument been successfully applied.

Gun Lock Spring Apparatus for Knee.

In the third class of cases greater difficulties exist. In the preceding descriptions power of the psoas muscles has been maintained, but where this is absent it is almost impossible to give much assistance. Another difficulty also presents itself, viz., the shortness of leverage from the centre of the hip joint to the top of the pelvic band and the relatively enormous leverage from the hip joint to the foot. The initiative in walking must proceed from the hip joint, and be this power ever so little, and the paralysis at the knee and ankle ever so complete, I have no difficulty in successfully applying mechanism. As an example of what can be done with slight power at the hip joint, I would draw attention to a case of almost complete paralysis of both lower extremities represented, Fig. 200, Pl. 37, and which was sent to me by a Surgeon, with the question,

Apparatus for Complete Paralysis of Lower Extremities.

"Can you do anything?" I must confess that on first examining the boy, I looked upon the case as one in which little mechanical assistance could be given. Fortunately, in both legs slight power still remained at the hip joints, and at the right knee there was a fair amount of extension force. The right foot as well as the left knee and left foot were completely paralysed. In addition to which there was a considerable condition of valgus and varus in the right and left feet respectively. To increase the difficulty of the case, the biceps and hamstrings of the left knee were much contracted, causing considerable inversion and rotation of the left leg below the knee. I carefully examined the case, and gave my opinion that the most to be done would be to apply apparatus as a sure preventive of further deformity, and a possible remedial measure for improvement of the contraction. As to the walking, I could not promise much, but I anticipated that if the contracted knee could be improved, that the lad would at all events be enabled to stand. This was explained to the Surgeon and to the patient's father, who, after some consideration, asked me to do what I could. I therefore constructed the apparatus, Fig. 202, Pl. 38; these were extended from the ground to the pelvis, with free joints at the hips, ring catch, and double knee caps, with garter pieces at both knees, and toe elevating springs at ankles. The object of the "double" knee cap was, firstly, to overcome any tendency to a condition of genu-valgum, and, secondly, to support the leg in standing and prevent any forward bending. In addition to this movement at the knees, I added a flexion "rack and pinion" joint to the left knee, so that the leg instrument for this limb could be first adapted to the contracted condition and then gradually

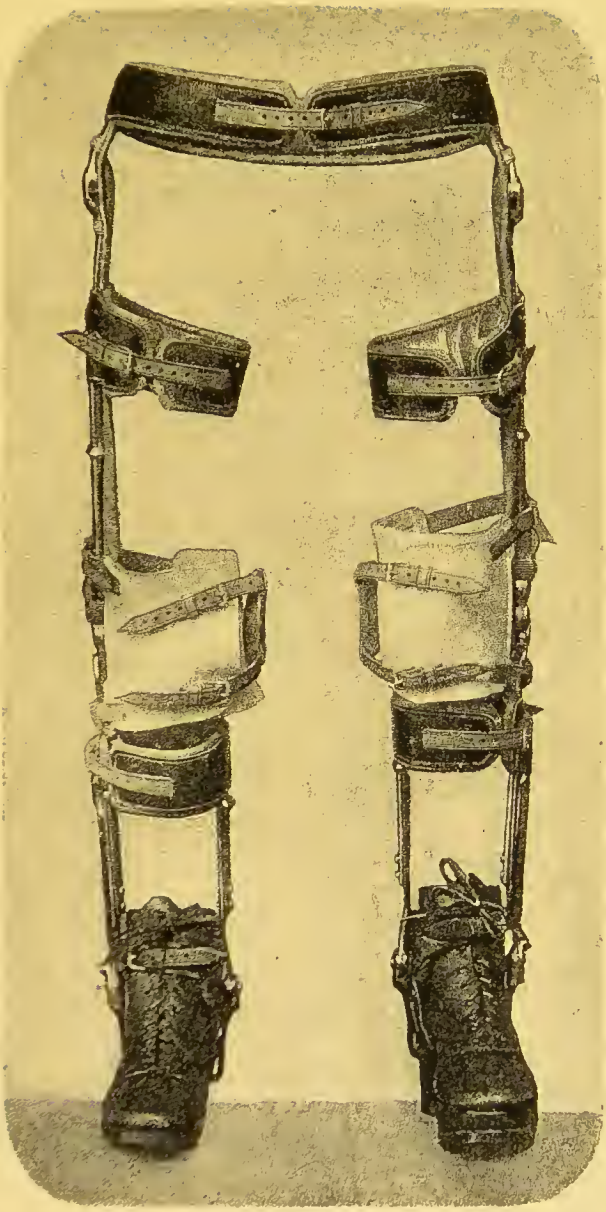


FIG. 202.

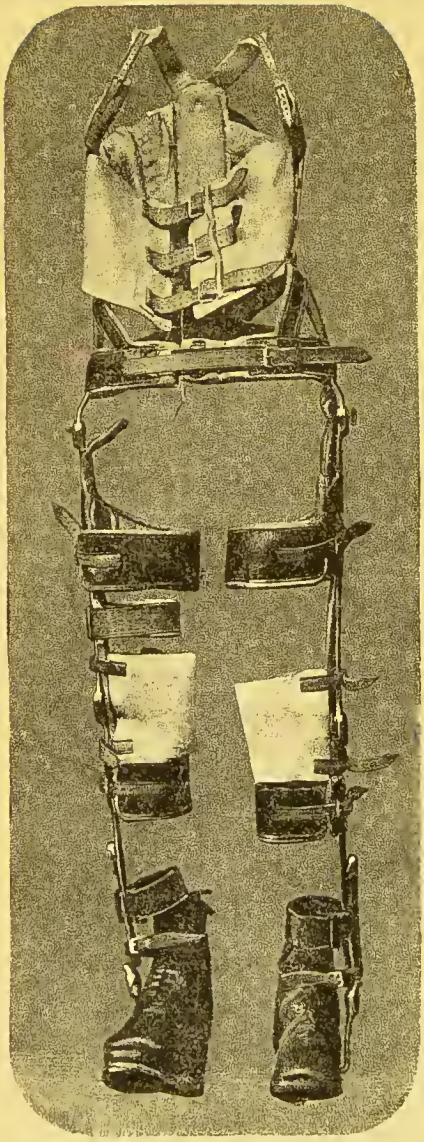


FIG. 203.

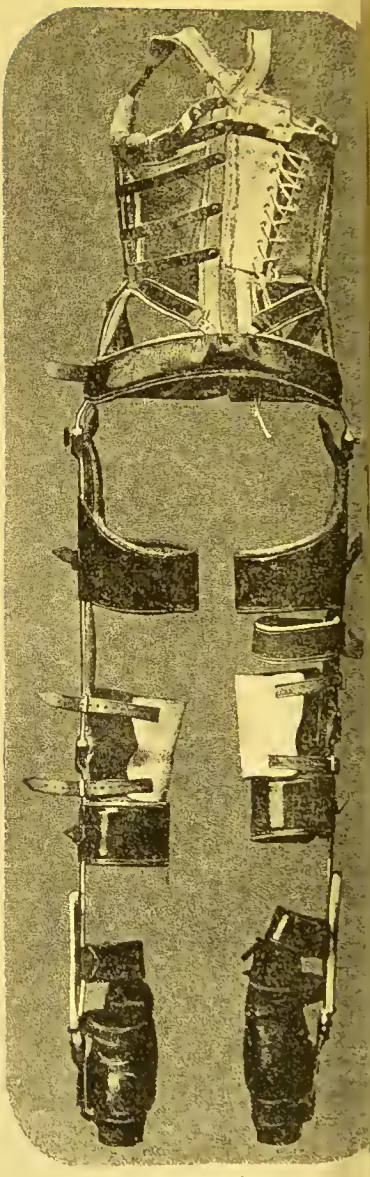


FIG. 204.

straightened. For the feet, provision was made for the condition of valgus and varus, and the left foot was furthermore supported by a boot with a one-inch cork sole, this leg being deficient in length to that extent. The apparatus are shewn applied to the lad, Fig. 201, Pl. 37, where it will be seen that he was immediately enabled to lay aside the crutches in standing. As I have before stated, I expected this result, but I did not anticipate hearing that he was enabled to dispense with his crutches in walking, or that he was even able to walk. The case is one of considerable interest, and I may, therefore, be excused for quoting the following extract from a letter sent to me by his father three weeks after the instruments were applied. He says, ". . . am glad to say that the instruments are a complete success. My lad can now put them on himself without any help, and keeps walking about with them all day long, and can even walk up and down stairs with them on. . . ."

Apparatus for Paralysis of Lower Extremities in conjunction with Spinal Curvature.

Often in conjunction with complete paralysis of the lower extremities, spinal deflection is occasioned by the inequality in the length of the lower limbs. In these cases, more help can be given in the way of spring mechanism at the hip joint, inasmuch as the extension of the instrument to the axillæ gives greater leverage for the employment of spring force. Fig. 203, Pl. 39, represents a set of walking apparatus lately constructed by me for a case of this description. The principal arrangement of springs and mechanism is of the kind already described, and the disposition of the support for the spinal curvature is fully represented, Fig. 204, Pl. 39.

Apparatus for Spastic Paralysis of Knee Joint.

The apparatus Fig. 205 Pl. 40 illustrates a set of walking apparatus which I have just completed for a case of spastic contraction of the biceps and hamstring tendons. The instruments are extended to the pelvis, and are double from the ground to the thigh on either side of the leg, being supplied with a ring catch joint at the knee. They are put on with the joint unlocked, and after the straps, etc., are adjusted, gradual extension is made, and when the limbs are fully straightened the ring is slipped down and the joint fixed in the axial line. In this condition the patient can stand without fear of collapse from bending of the knee. This instrument is suitable for the severer forms of contraction, but in slight cases it is as well to combine rigidity with possible mobility. This is very completely carried out in the apparatus Fig. 206, which is composed of a light double steel support from the calf to mid-thigh. The ring catch joint is supplemented by the addition of the spiral spring with chain connection, which enables the patient to walk with free movement at the knee, at the same time giving entire support from the springs. This form of instrument is exceedingly light, and is also very serviceable in cases of locomotor ataxy.

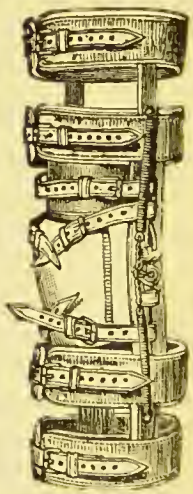


Fig. 206.

The foregoing inventions give a very general description of the kind of aid that can be given to these unfortunate cases. Without doubt, much yet remains to be carried out, but when

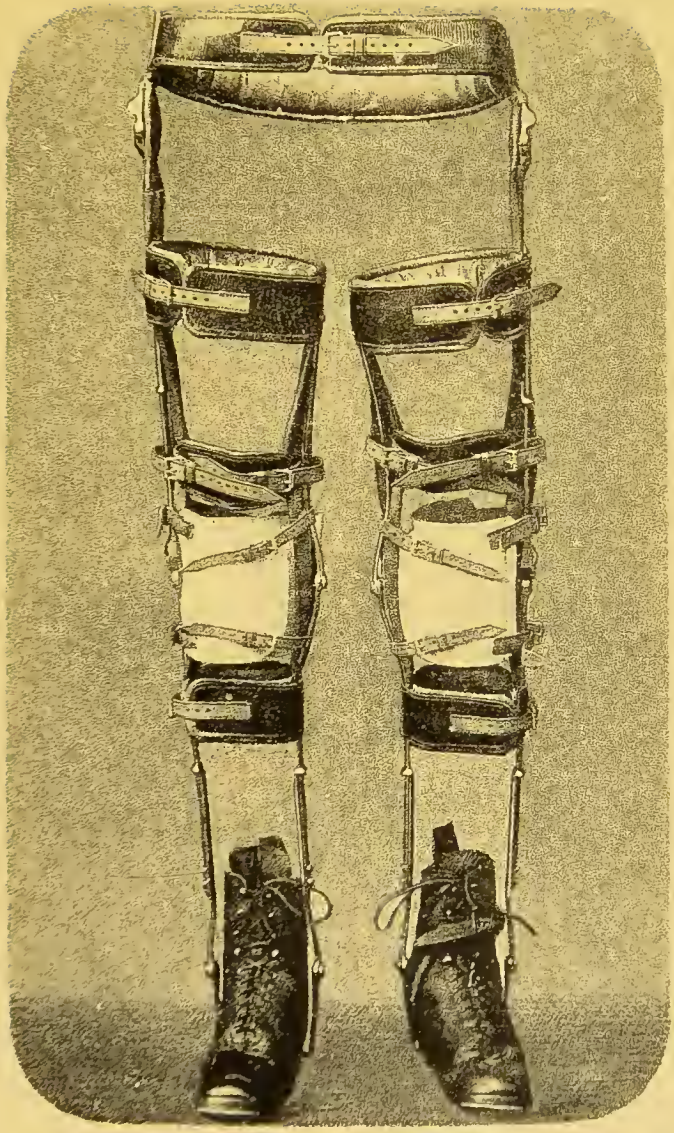


FIG. 205.

such help as I have described is already afforded, I think that the application of mechanism to paralytic cases is not entirely useless; and I confidently look forward to a time when they may still further be benefitted by the future researches of science.

CHAPTER X

Hammer Toe and Bunion.

The troublesome deformity of hammer toe has lately occupied considerable attention, as to the best method of obtaining a radical cure, and in common with some other deformities, has advocates both for tenotomy and osteotomy. It is principally for the former mode of treatment that mechanical appliances are necessary.

Fig. 207 represents a typical case of hammer toe, and for which I made the following mechanism. After the division of the lateral ligament, the toe was placed in a small flexible metal splint, such as described for the first stage of congenital varus and applied on the dorsum of the foot. The toe was kept at rest for three days after the operation, when the metal shoe sole-plate with slots was brought into use, Fig. 208, Pl. 41. This is simply a sole-plate of metal, with a blocked leather heel, the foot is attached by a heel and instep strap A B which forms a point of fulcrum, and prevents any tendency to displacement. At the end of the sole-plate slots are cut according

Fig. 207.

Metal Shoe with Slots or Hammer Toe.

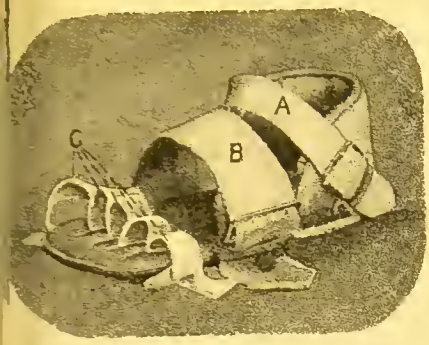


FIG. 208.

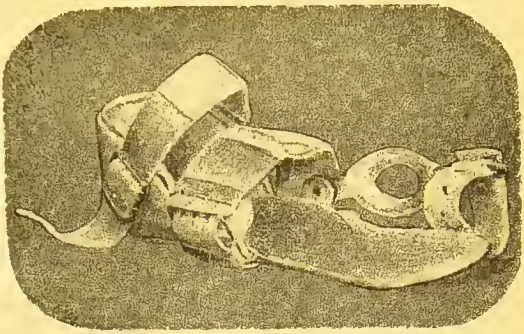


FIG. 213.

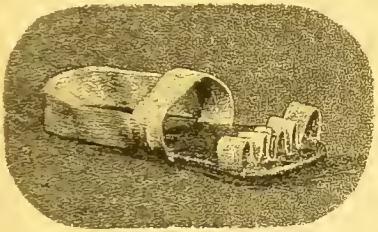


FIG. 210.

FIG. 209.

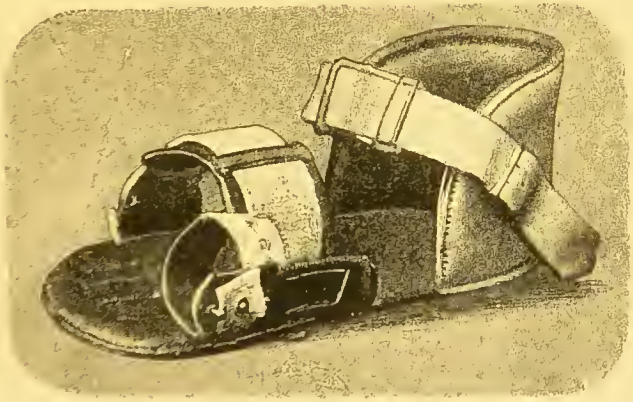


FIG. 212.

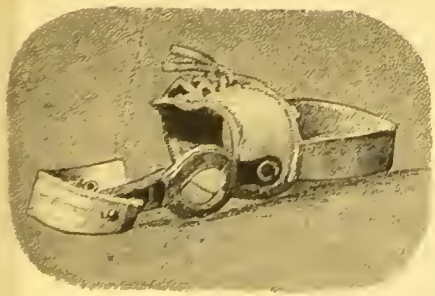


FIG. 215.

FIG. 214.

to the number of toes involved and the extension made by the tapes C. To facilitate extension, it has generally been found advisable to place a small pad under the extreme end of the toe, this being gradually increased in thickness as the improvement progresses. It is observable that the pressure is exerted in contrary directions, downwards by the tape and upwards by the pad, a small pledget of lint being placed under the tape to prevent cutting of the edges. This shoe is worn day and night for about three weeks, after which time a T spring is requisite. This, Fig. 209, Pl. 41, is a retentive apparatus, and is always used for some little time after the cure. It is carefully adapted to the sole, and kept in position by a broad elastic band encircling the foot behind the great toe joint. The extension, or rather retention of the toe is made by a small elastic band applied behind the first joint of the affected member. The spring is worn in an ordinary boot, and offers no obstruction to walking. To prevent any possibility of relapse, and as a lighter and less cumbersome apparatus and also to facilitate the application, I generally recommend the half-metal sole-plate, Fig. 210 Pl. 41. This is similar to the shoe for treatment, but dispenses with the heel-piece. It has elastic loops for the toes, and is easily applied. It is of course very essential that broad-toed boots should be worn after treatment, and in all cases the measurement

T Spring for Hammer Toe.

Half-Metal Sole-Plate.

Fig. 211.

should be taken with the T spring attached to the foot. Fig. 211 represents the case of hammer toe I have illustrated, when cured.

It is not unusual to find inverted great toe combined with cases of hammer toe, and here it is better to combine mechanism for the cure of both deformities. Fig. 212, Pl. 41 illustrates a very convenient form of shoe with simple spring arrangement. To the ordinary hammer toe shoe I attach a convex spring fixed to the sole-plate behind the great toe joint. This spring is curved convexly towards the toe, and the everting force is obtained by a small toe-strap, which passes round the toe and draws it in the direction of the spring. By a series of studs fixed to the spring it is possible to regulate the exact tension. With this movement it is advisable to have a counteracting strap directly behind the spring, which should hold the foot in position. This strap is made to act efficiently by starting from the centre of the sole-plate and buckling to the outer border of the shoe. In some cases the enlargement of the joint may give trouble in the application of the flat steel spring, and in such circumstances the modification of the shoe as shewn Fig. 213, Pl. 41, will be found to answer. In addition to the altered shape of the spring this is attached to the shoe by a joint which permits flexion movement. Should the spring force be objected to, the rigid eversion of the toe wire may be substituted. This is depicted Fig. 214, Pl. 41, and needs no detailed description. Sometimes it is necessary to have a more powerful action than the spring force, and I recently made a shoe for treatment of inverted

Metal Shoe for Combined Hammer Toe and Inverted Great Toe.

Modified Shoe for Eversion of Great Toe.

Shoe with Toe Wire for Eversion of Great Toe.

Extension Shoe for Inverted Great Toe.

great toe complicated by a tendency to downward contraction. To the ordinary shoe with heel-piece, but in place of the spring, I substituted a small double-action rack and pinion movement, having a flexion and extension and eversion movement. This mechanism corresponded to the joint in position, and was extended to the end of the toe by a small lever. This plan enabled the lever to be adapted to the axis of the toe, and was attached by a narrow strap and buckle, to which I fastened a small trough of poroplastic in order to diffuse the pressure of the strap. By gradual extension the toe was entirely straightened, and a most successful result obtained. In ordinary cases of bunion, and especially

Bunion Spring.

where pain is caused by the contraction of the extensor tendon, I have found the bunion spring of great service. It is considerably lighter than the sole-plate, and equally perfect in its action, although it is not suitable for the severer forms of inversion. It consists, Fig. 215, Pl. 41, of a metal plate, which is adjusted to the foot, at the instep, on the lower part of the plate, a spring is jointed and curved convexly towards the toe, having a special feature in the division of the spring over the bunion, by which means all pressure on the joint is obviated. As a light retentive sole-plate the half-metal

Half-Metal Sole-Plate with Upright Divisions.

plate with upright divisions may be used. With reference to any appliance for walking I have found the greatest difficulty in adapting retentive appliances for this purpose, as so much depends upon the condition of the

Appliances for Walking.

toe. In very slight cases, as a preventive, I have used a leather cap or thimble attached to the great toe, and fastened to the heel by a tape with elastic insertion.

In other cases an upright division is inserted in the boot, but the difficulty exists in introducing the toe into the space left for its use. A very ingenious instrument was devised by Dr. Dick, and consisted in a V shaped spring, which was worn between the great and second toe, with the apex of the V resting against the web, and the sides of the spring respectively attached to the great and second toe by elastic bands. My experience, however, shews that if the sole-plates are worn perseveringly at night, and if possible, part of the day, with good roomy and particularly straight boots along the inner border of the foot, they are sufficient to prevent any chance of relapse. How difficult it is to get patients to wear these boots can be better understood by the medical profession than the public, whose notion and use of a pretty (?) boot causes more deformity and suffering than it is possible to conceive.

CHAPTER XI.

Artificial Limbs for Amputations and Congenital Deficiencies and Malformations.

In the construction of artificial limbs for the upper or lower extremities a great diversity of opinion exists as to the mechanism that can be employed. I refer principally to those of the upper extremities and where more need is necessary for the replacement of the functions of the lost member. There have been many attempts made to construct arms and hands with automatic and spring movements—very perfect mechanism of its kind,—but, owing to the exceedingly limited space for the insertion of the mechanism, especially in the fingers, these movements are liable to become easily deranged, and consequently useless. I have now had considerable experience in the construction and fitting of artificial limbs, and it is my opinion that the simpler the mechanism the more perfect and useful the action. With the replacement of a leg the patient is enabled immediately to walk, and it at once becomes of the greatest service; not only this, there are few cases in which I have not found the patient capable of dancing and riding. Practically speaking, the limb is restored, but with the upper extremities the case is very different. Generally an arm or hand is applied for appearance; many things may be done, such as using a knife or fork, holding papers or cards, but all

require a special instrument for the purpose. There is, however, one improvement in the construction of arms for amputation below the elbow, which I have found to be of great utility, and this is an automatic rotation movement at the wrist joint. It is principally applicable to cases where the amputation is near the elbow joint, leaving a short stump. The full flexion of the arm cannot be obtained owing to the fitting of the arm socket, and it is impossible to bring the fork to the mouth without rotating the arm. I had a case in which this difficulty arose, and which I very successfully overcame by adapting a spring movement at the wrist, that was acted upon by an elbow cap connected to the movement by a gut band. This is the only automatic movement which I have found serviceable. In enumerating the several forms of artificial limbs I shall divide them into five classes :—

1. Limbs for amputation above the knee joint.
2. Limbs for amputation below the knee joint.
3. Limbs for amputation above the elbow joint.
4. Limbs for amputation below the elbow joint.
5. Limbs and apparatus for congenital deficiencies and malformations.

1. Limbs for Amputation above the Knee Joint.

Bucket Leg for above Knee Amputation.

The simplest form of leg is the Bucket Leg, Fig. 213, Pl. 42. This consists of a simple wooden bucket with pin attached and fastened to the body by a pelvic-strap. The limb can be made with a spring stop joint, to enable the pin to be bent whilst sitting. I do not generally advise it, as it soon becomes shaky from constant wear. This is the only kind of

FIG. 214.

FIG. 217.

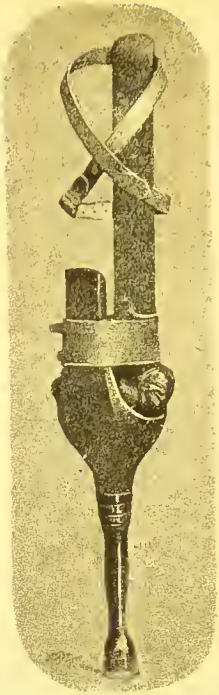


FIG. 215.

FIG. 213.

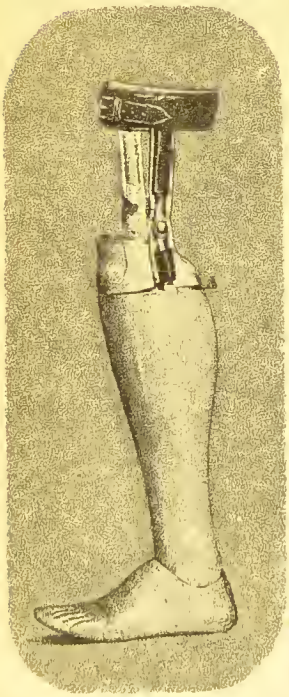


FIG. 218.

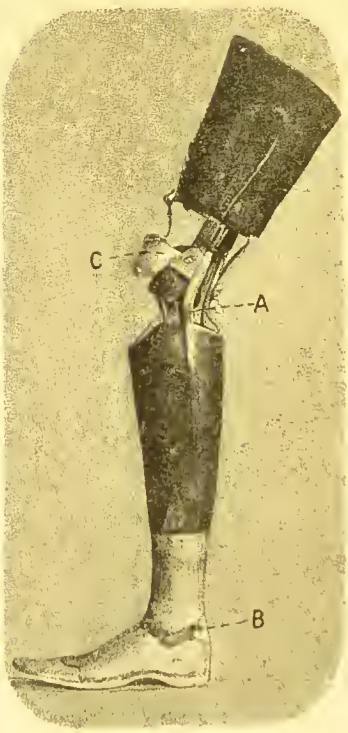


FIG. 219.

FIG. 216.

limb suitable, in an economical point of view, for hospital cases.

Fully Articulated Limb for above Knee Amputation.

The next form is the fully Articulated limb, for thigh amputation, Fig. 214, Pl. 42. In construction this is one of the most complicated limbs to make, and one in which there is the greatest difficulty to teach patients to use, especially in cases of short stump. It is constructed entirely of willow and lime tree, with all fully articulated joints, and fitted with the tendon movement. The limb is attached to the body by braces passing over the shoulders. The great difficulty in commencing to walk with this form of limb consists in keeping the knee joint well under the body, and maintaining the axis of the limb. In taking the step the leg should be thrown well forward, and the heel planted firmly on the ground. The knee should then be straightened, and the weight of the body will be sustained without fear of collapse at the knee. At first this movement will be arduous, but with practice the action will be easily acquired, and a natural gait obtained. I have recently fitted a limb to a patient, with a stump only two inches in length from the hip joint, with perfect success.

2. Limbs for Amputation below the Knee Joint.

Kneeling Pin Leg.

The Kneeling Pin Leg, Fig. 215, Pl. 42, is very useful in cases of anchylosis of knee joint, and for hospital purposes. It is also very serviceable in the treatment of cases of disease of the ankle joint, where, by the addition of a cradle, complete rest is given to the joint, and the patient enabled to get about.

Artificial Pin Leg, without Articulations.

As a cheap form of artificial leg for hospital use, Fig. 216, Pl. 42, represents a serviceable instrument, which may be used where the amputation exists at the lower third of the limb. It is attached to the limb by an above knee strap, and is very durable in wear. Where the amputation is close to the joint, it is advisable to use a thigh bucket, so that

Artificial Pin Leg, with Knee Joints.

the bearing may be entirely from this point; Fig. 217, Pl. 42, represents this. The thigh bucket is attached to the lower bucket by metal stems jointed at the knee. There is one advantage in this form of limb, namely, that the bearing being entirely at the thigh, the stump does not atrophy so much as when the bearing is entirely below the knee joint. In cases of long fleshy stumps, an articulated foot

Artificial Leg for Long Fleshy Stump.

is usually applied. Fig 218, Pl. 42, illustrates this. The bearing is taken from a leather pressure cap, fitted below the patella, and resting on the upper edge of the

Artificial Foot for Syme's Amputation.

leg bucket. Fig. 218a represents the most approved form of foot for Syme's amputation, and is amply described by the annexed woodcut. The most perfect limb is that depicted, Fig. 219,

Fully Articulated Limb for below Knee Amputation.

Pl. 42, the fully articulated limb for below knee amputation. The chief feature consists in the tendon movement A. This corresponds to the tendon achilles, takes its origin from above the knee joint, and is inserted into the heel at B.

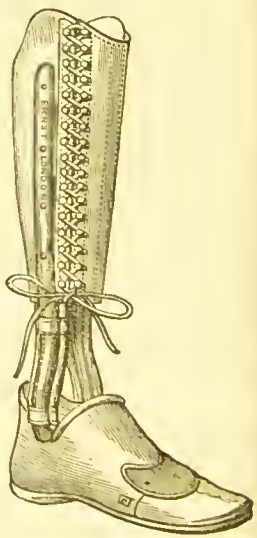


Fig. 218a.

This bears the entire strain at the ankle joint and produces

that natural gait which is so important in the use of artificial members. The attachment of the limb is of great consequence. Where possible, I endeavour to avoid the use of braces in below knee amputations. Under any circumstances they are troublesome, producing bearing down and great strain. I attach my artificial limbs by the above patella strap C. This fixes the artificial limb to the leg, and both work as one. I have seen many cases, where perfect mechanism has been applied, entirely fail for want of this strap. By its use the limb is firmly connected, without undue pressure, and all tendency to slip is avoided. With reference to the fitting of limbs, it is of the utmost importance that the bucket should fit the stump accurately. If this is carefully attended to, the success of the case is absolutely certain.

3. Limbs for Amputation above the Elbow Joint.

Much depends in this class of cases upon the social position of the patient as to the form that the limb should take. In hospital practice the common arm socket with hook is of great service, and is generally supplied. It is so well known that it needs no comment. I had a case a few years back sent me from one of the London hospitals, that of a railway porter, who had both arms amputated; the right at the shoulder joint, and the left four inches below the shoulder joint. I fitted him with a common arm socket to the right, and a fully articulated arm to the left, with which he was enabled to do many things, and eventually take a situation which rendered him self-supporting. As an indication of the more expensive class of work, I would refer to Fig. 220, Pl. 43,

Common Arm Socket.

which represents a fully articulated arm for amputation at the shoulder joint. The limb was attached to the body by a cross axillary strap, the flexion of the elbow being arranged for by a spring catch which fastened into a series of holes, so that the angle of flexion could be altered at will. The wrist joint was made to rotate and detach in order that a riding hook might be applied when requisite. The peculiarity of the riding hook consisted in the centre of the hook being jointed with a spring movement which at a certain pressure gave way, the result being that the reins were loosed and the attachment of the hook to the arm freed. This hook is specially serviceable for use in the hunting field or when riding a restive horse, assuring an absolute immunity from accident by dragging.

Articulated Arm for Amputation at the Shoulder Joint.

4. Limbs for Amputation below the Elbow Joint.

Fig. 221, Pl. 43, represents an articulated hand and arm for below elbow amputation; it is to a case of this class that the rotation movement, already described, was attached. Fig. 222, Pl. 43, represents an arm-socket and hand, suitable for cases of long fleshy stump. It is advisable to connect the limb to the arm by an above elbow bandage. At Fig. 223, Pl. 14, I have illustrated several types of instruments suitable for use, but many more are constantly made from time to time according to the requirements of patients. At Fig. 224, Pl. 43, I have illustrated the way in which a fork is adapted to the hand.

Artificial Hand and Arm for Below Elbow Amputation.

Arm-Socket and Hand.

FIG. 220.

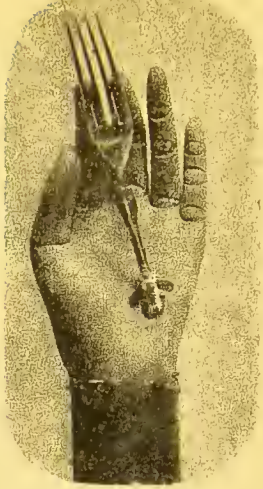


FIG. 224.

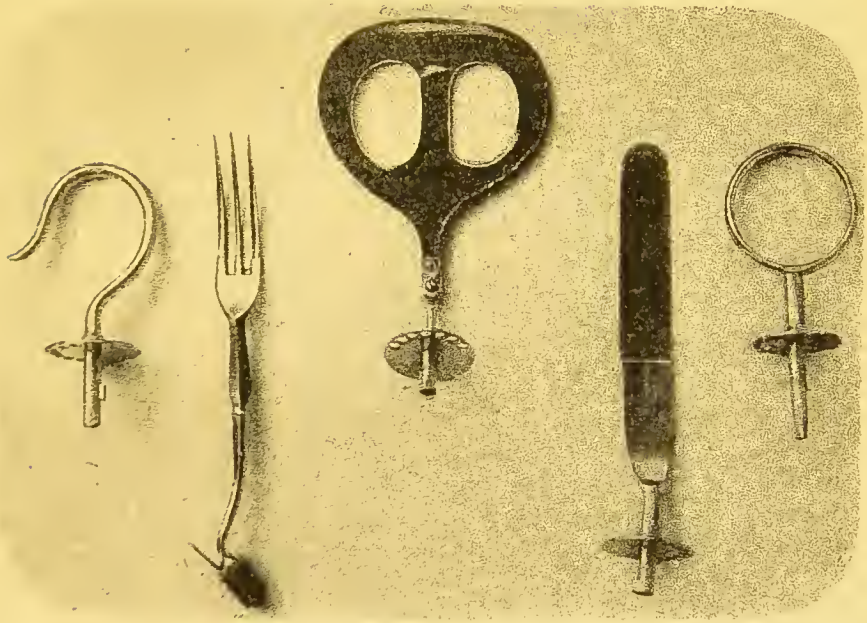


FIG. 223.

FIG. 221.

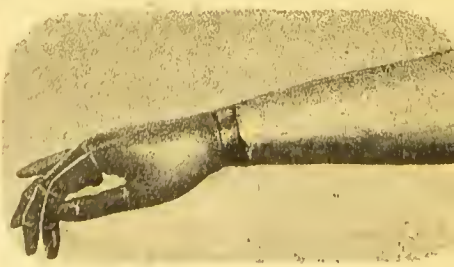


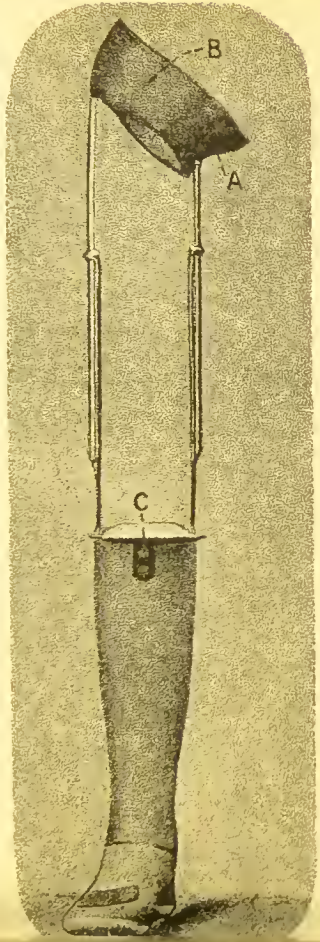
FIG. 222.

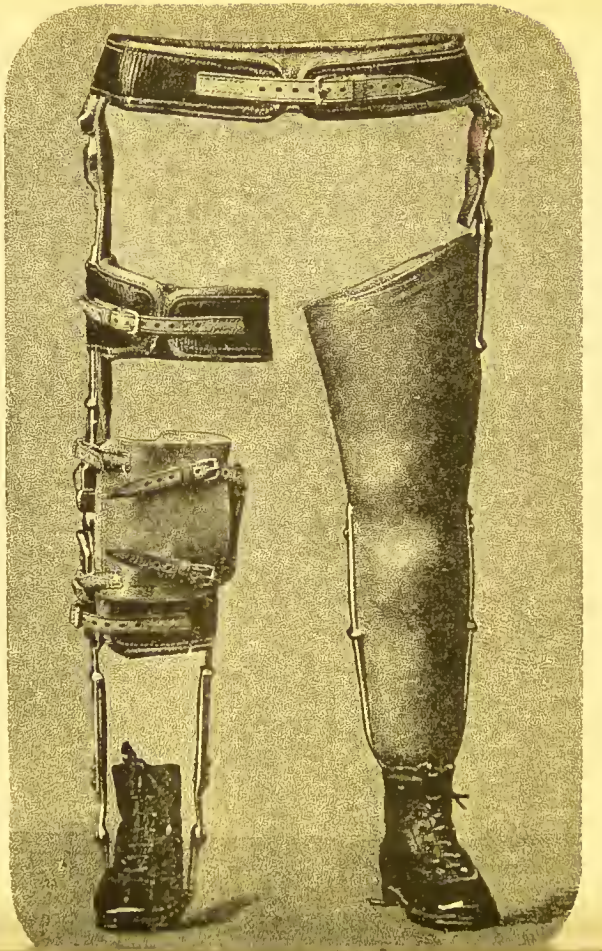
5. Limbs and Apparatus for Congenital Deficiencies and Malformations.

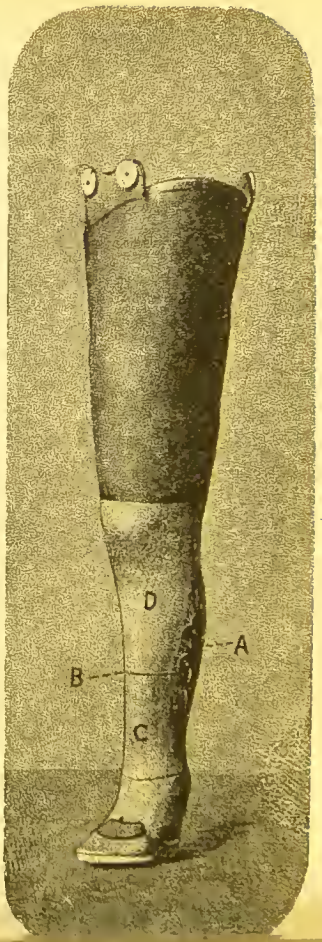
In the many and varied cases of these painful afflictions that have been brought before me, it has constantly been my desire to publish the results that have been obtained by the application of mechanism, not only as a demonstration of the good that can be attained, but as a relief to those who are similarly afflicted and not aware of the assistance that can be rendered. Unfortunately, in the large number of cases, which have come under my notice, I have been unable to obtain photographs or drawings of the actual cases, a delicacy of feeling has prevented a request to do so, and where the request has been made, permission has not been given. On consideration one cannot be surprised that this permission has been withheld, although in the cause of science, and as a help to others one would like to be able to add yet another testimony to the value of mechanism. I am, however, enabled to give illustrations of apparatus that I have made, which will afford some insight into the great assistance that can be rendered. Most especially in deficiencies of the lower extremities are the greatest results obtained. The relative good derived is in the same relation as that of ordinary artificial legs to arms. The first case I would draw attention to is that of a gentleman for whom I have made apparatus for some considerable time. He has a deficiency of the left lower extremity from the knee joint; the tibia and fibula are absent, and the foot articulated at the end of the femur. There exists perfect movement at the ankle joint, and complete articulation at the hip joint. I am therefore enabled to obtain a firm bearing from the sole of the foot as the

basis for carrying the weight of the body. It is remarkable that owing to the constant use of the ankle joint, as a knee joint, the patient has almost perfect flexion, corresponding to the normal knee joint of the opposite limb. The apparatus is carried to the pelvis by side-uprights, with a free joint at the hip, and attached to the thigh by a wide thigh bandage. The lower portion of the apparatus is constructed after the same principle as the below knee artificial leg with tendon movement. With the exception of a slight difference in the size of the left leg of the trousers, very little is noticeable in the appearance or the gait, and this gentleman can walk ten miles without the slightest fatigue, and is also able to take his share of tennis, rowing, and a variety of out-door exercises and amusements.

In juxta-position with this case I would mention that of a young gentleman, whom I saw twelve years ago, with (what I imagined at that time to be) a similar deficiency, only of the right leg. When he was a year-and-a-half old I made him a slight apparatus, without much mechanism, permitting him in his infantile way to move about freely; but at the age of six he commenced to limp considerably, and seemed to be developing spinal curvature. I should mention that previously, the foot—which was attached at the end of the femur—was operated upon, owing to the existence of severe equinus, and it was anticipated that if the foot could be brought to a right angle that it would form a good base of support. It did so for four-and-a-half years, but after that time the limping, before mentioned, appeared. On careful examination, by the surgeon who operated on the case, it was ascertained that this drooping was occasioned by the entire absence of the acetabulum, and







PLATE

that the head of the great trochanter could be felt distinctly moving upwards a space of two inches. The foot was therefore of no use as a base of support, and I had to entirely remodel my apparatus. This I did, taking my bearing from the tuberosity of the ischium, and using the foot as a point of extension to retain the hip joint in position. The apparatus is shown Fig. 225, Pl. 44. The perineal ring B is carried under the ischium at A which forms the base on which the trunk is supported. The foot is attached by means of a gaiter to the sole plate C. The lower part of the limb is constructed in the ordinary manner. The patient, who is a strong, healthy lad, is scarcely ever still, and joins eagerly in all the school games, thereby fully demonstrating the value of his artificial help.

I will describe one other case of congenital malformation. This is of a young lady now eight years of age, where the deficiency exists at the middle third of the left femur. This is a comparatively easy case, as the stump closely resembles one of ordinary amputation. However, a malformation also exists in the leg of the right limb, the tibia and fibula being fused, and terminating in a rudimentary foot. There is also considerable tendency to genu-valgum of the right knee, evidently due to osseous deformity. I have illustrated the apparatus which has been supplied to this case for some time past, and which is eminently successful, Fig. 226, Pl. 44. The left extremity consists of a leather moulded limb without articulations (at present the little patient would be unable to manage the knee joint) which is connected by a side stem with hip joint to the pelvic band of the right leg apparatus. This leg instrument (right) is arranged

with a garter-piece and double knee-cap at the knee, and a ring catch movement, which, in combination with a trough splint at night, has already much relieved the tendency to genu-valgum, and there is no doubt that by perseverance in the treatment the limb will be quite cured of this affection. In addition to these walking apparatus, I have also made for her a riding leg Fig. 227, Pl. 44, which contains a novel invention that I have not before seen attempted. This consists of a means of rapid detachment in case of a fall or throw from the horse, so that the terrible results of being "dragged" may be effectually avoided. The limb is divided at B and the lower portion C is attached to the upper D by a central pin filed flat on one side to prevent rotation. The part C is kept in apposition by a spring catch A which is only sufficiently strong enough to keep the limb together whilst the step is taken in walking. An ordinary slipper stirrup is used, and the leg fastened to the stirrup by a strap attached to the stirrup-iron. Should an accident occur, the foot (the only part which can hold in the stirrup) is immediately drawn away by traction, and alone left attached to the saddle.

I have rather fully described these cases, and could multiply them, but I think I have given examples sufficient to demonstrate how much can be done by judiciously devised mechanism.

CHAPTER XII.

Trusses for Inguinal, Femoral, Umbilical Hernia, and others.

The various forms of trusses applicable to cases of hernia are already so well known that it may seem superfluous to draw particular attention to any one kind. There is as much difference of opinion as to the best form of truss, as in the application of other apparatus, and it is often a question of experiment to decide what form is most suitable. The following kinds are adaptable both for inguinal and femoral hernia, the difference merely being in the shape of the neck and the head. In slight cases the ordinary single or double truss is sufficient. The success in the application of this, consists in the adaptation of the spring, which should be arranged to fit the pelvis accurately. The bathing truss, Fig. 228, Pl. 45, covered in rubber is of the same construction. In more severe cases the truss invented by Dr. Dick, has been found of great service, and I have frequently applied this to the worst kinds.

Dr. Dick's Auxiliary Spring Truss.

Fig. 229, Pl. 45, indicates the nature of the auxiliary spring, in which the pad A is shewn to be in a different plane to that of the body spring, by the addition of this auxiliary spring a direct uplifting force is obtained, the body spring merely acting to keep the pad in position. The advantage therefore obtained is very considerable, inasmuch as the truss need not be fastened unbearably tight to obtain the necessary and supporting power.

Cross-spring Truss.

Fig. 230, Pl. 45, represents this form, which has the advantage of encircling the pelvis on one side only. It is suitable for very slight cases, on account of the pressure of the strap being unbearable when the rupture is severe. The peculiarity in this truss rests in the spring supporting the hernia from the opposite side: this passing over the pubes from left to right for a right hernia, and *vice versâ*.

Adjustable Truss, with Rotation Movement in Pad.

This apparatus, Fig. 231, Pl. 45, has the advantage of an adjustable head, arranged for by a small rotation rack and pinion movement at A. This alters the position of the plane of the pad, and materially assists in the adjustment, especially where there is any tendency of the hernia, or omentum, to slip under in severe cases.

Double Truss, with Pressure Plate at Back.

Often in cases of double rupture the pressure of the spring cannot be tolerated on the sacrum, and in such cases it is frequently relieved by a back plate A, Fig. 232, Pl. 45, which is fitted with conical springs, these greatly relieve the rigid pressure, and the size of the plate diffuses the area of the counter pressure.

Truss for Umbilical Hernia.

The best form of truss for Umbilical Hernia is that illustrated in Fig. 233, Pl. 45, and is especially adapted for cases of a moderately severe nature. It consists of two lateral springs A B hinged and attached to the abdominal plate at C C. This plate is made to cover a large area, so that support may be given to the abdominal walls, as well as to the hernia itself, which is arranged for by a conical pad attached to the inner surface of the plate.

Single Truss for Umbilical Hernia.

In slight cases I have lately invented a single spring truss which has been found to answer

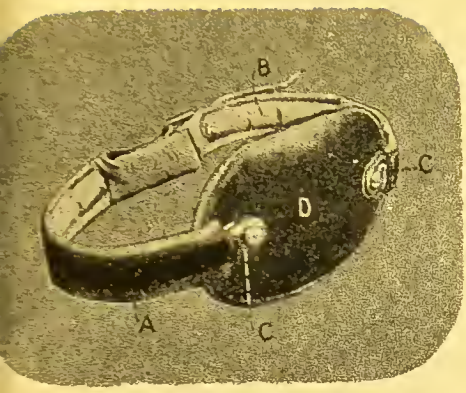


FIG. 233.

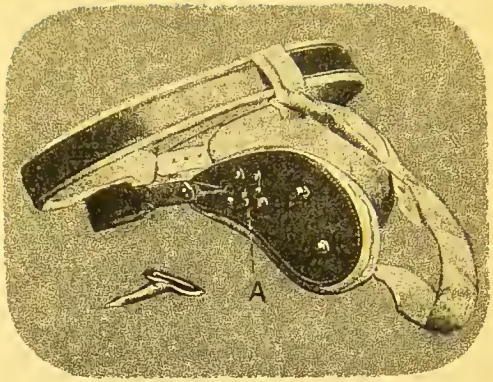


FIG. 231.

FIG. 230.

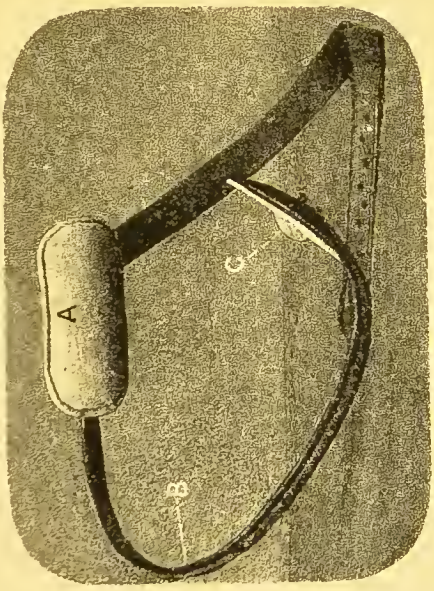


FIG. 234.

FIG. 228.

FIG. 232.

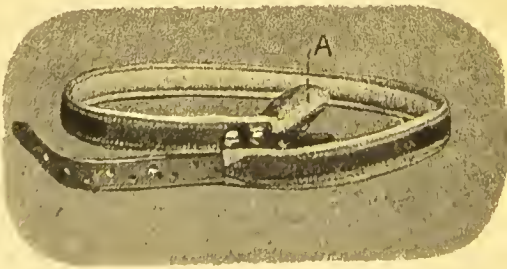


FIG. 229.

admirably, and is exceedingly light, and keeps its position well in wear. It is shown Fig. 234, Pl. 45, and consists in a counter pressure plate A to which is attached the spring B this being connected to the abdominal plate C. The principal point in this truss is the shape of the spring which is hammered to bring the counter pressure plate exactly on the waist line, by this means no displacement occurs. The truss is suitable both for males and females. Similarly in design I have successfully fitted a truss for supporting "floating kidney," and with every comfort to the patient. The above give a very general idea of the form of apparatus used for hernia. There are so many ways of modifying trusses that it would be quite impossible to enumerate all here. The pads may be made of ivory, vulcanite, water, air, &c., but the construction of the spring is the same. The success in the application is effected by the adaptation of the main spring, for if this be not very carefully moulded to the pelvis, the pad will constantly be liable to derangement. There are also many other forms of truss required, *e.g.*, such as Prolapsus Ani, Fig. 235. This is made with a pelvic band, to which is fixed a main spring at the back, held in position by straps and buckles. An ivory pad is connected to an auxiliary spring, which is fastened to the main spring. This gives the necessary support to the prolapsed rectum. Also in cases of scrotal, ventral, and for the rarer cases of vaginal hernia, special apparatus are made.

Truss for floating Kidneys.

Truss for Prolapsus Ani.

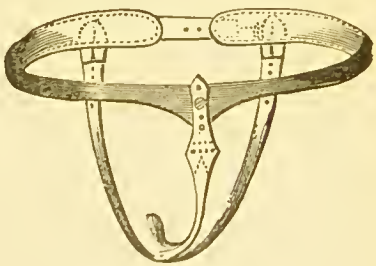


Fig. 235.

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